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Monitored Natural Attenuation 2005 Performance and Compliance Monitoring Annual Report for Test Area North, Operable Unit 1-07B

May 2006

Idaho Cleanup Project

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Idaho Cleanup Project
Idaho Falls, Idaho 83415

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ABSTRACT

Monitored natural attenuation is the remedial component of the distal zone of Test Area North, Operable Unit 1-07B, which comprises the largest total area of the contaminant plume. This report presents a compilation and analyses of volatile organic compound and radiological data collected in support of the monitored natural attenuation remedy at Operable Unit 1-07B during Fiscal Year 2005. Groundwater monitoring followed the performance and compliance strategy, as described in the *Monitored Natural Attenuation Remedial Action Work Plan for Test Area North Final Groundwater Remediation, Operable Unit 1-07B*. This document presents the Fiscal Year 2005 groundwater monitoring activities, analytical results, data evaluation, and recommendations. The groundwater monitoring data suggest that the monitored natural attenuation remedy continues to trend toward meeting remedial action objectives.

CONTENTS

FIGURES

TABLES

ACRONYMS

bls	below land surface
cis-DCE	*cis*-dichloroethene
DO	dissolved oxygen
DOE-ID	U.S. Department of Energy Idaho Operations Office
EDF	engineering design file
EPA	U.S. Environmental Protection Agency
FLUTe™	Flexible Liner Underground Technology
FY	fiscal year
ICP	Idaho Cleanup Project
ID	identification
IET	initial engine test
ISB	in situ bioremediation
MCL	maximum contaminant level
MDA	minimum detectable activity
MNA	monitored natural attenuation
MS	matrix spike
MSD	matrix spike duplicate
NA	not applicable
OU	operable unit
PCE	tetrachloroethene
QA	quality assurance
QC	quality control
RAO	remedial action objective
RPD	relative percent difference
TAN	Test Area North

TCE	trichloroethene
trans-DCE	*trans*-dichloroethene
TSF	Technical Support Facility
USGS	United States Geological Survey
VOC	volatile organic compound

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1. INTRODUCTION

The purpose of this annual report is to document progress of the monitored natural attenuation (MNA) component of remediation at Test Area North (TAN), Operable Unit (OU) 1-07B at the Idaho National Laboratory during Fiscal Year (FY) 2005 (October 2004 through September 2005). The MNA performance is being tracked by periodic measurements of contaminant of concern concentrations throughout the groundwater plume. This report presents concentration data that will be used to determine if observed trends in the data support the predicted rates of attenuation for contaminants of concern. Groundwater monitoring, analysis, and well maintenance activities are reported in Section 2. Section 3 presents analytical results, and evaluation of these results is presented in Section 4. Section 5 presents a summary of results for this reporting period and recommendations for future activities.

1.1 Overview of Monitored Natural Attenuation Remedy

From about 1953 to 1972, liquid waste was generated at TAN from several experimental and support facilities used for nuclear research and development. These activities generated liquid waste and sludge, which were disposed of by injection into the Technical Support Facility (TSF) -05 injection well. The waste consisted mainly of industrial and sanitary wastewater but also included organic, inorganic, and low-level radioactive wastewaters. The resulting trichloroethene (TCE) groundwater plume emanating from TSF-05 is approximately 2 mi long. Because of the size and distribution of TCE, the plume was divided into three regions (DOE-ID 2001), as follows:

- Hot spot (>20,000 µg/L TCE)
- Medial zone (1,000 to 20,000 µg/L TCE)
- Distal zone (5 to 1,000 µg/L TCE).

The *Record of Decision Declaration for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites Final Remedial Action* (DOE-ID 1995) for the TAN groundwater contamination selected pump-and-treat as the default remedy for all three plume sections. However, it allowed for evaluation of innovative technologies, including enhanced in situ bioremediation (ISB) and MNA, for their potential to replace pump-and-treat. For the distal portion of the plume, MNA was evaluated as a remedy. The results indicated that TCE was being aerobically degraded relative to two internal tracers: tetrachloroethene (PCE) and tritium (Sorenson et al. 2000). Based on the MNA field evaluation results, the Agencies (i.e., Idaho Department of Environmental Quality, U.S. Environmental Protection Agency [EPA], and U.S. Department of Energy Idaho Operations Office [DOE-ID]) accepted MNA as the selected remedy for the distal portion of the plume (DOE-ID 2000). The *Record of Decision Amendment Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action* (DOE-ID 2001), signed in September 2001, documents regulatory approval of MNA as the final remedy for the distal portion of the plume.

To best implement this remedial strategy, the groundwater-monitoring program was divided into three distinct monitoring zones (Zones 1 through 3) and two operational phases (performance operations and long-term operations). The boundary of each monitoring zone is based on the expected time required to identify contaminant concentration trends at wells within that zone in order to confirm that TCE is

being degraded as expected. Zone 1 is the upgradient portion of the plume where the peak breakthrough is expected to be confirmed during the 10 years following approval of the MNA Remedial Action Work Plan. Zone 2 is the downgradient portion of the plume where confirmatory concentration trends might require 20 years or more from the approval of the MNA Remedial Action Work Plan to collect. Zone 3 is the area outside the downgradient extent of the plume where groundwater data will be used to monitor plume expansion. Figure 1 illustrates the three zones.

The completion of the MNA final inspection on October 16, 2003, as documented in the *Monitored Natural Attenuation Final Inspection Report* (ICP 2004), marked the start of the MNA component of the distal zone remedy. The performance operations phase is currently underway to confirm the effectiveness of MNA through the annual collection and analysis of pertinent groundwater data. The duration of this phase will be determined based on the results of data collected. The first and second rounds of annual sampling, compliant with the *Monitored Natural Attenuation Remedial Action Work Plan for Test Area North Final Groundwater Remediation, Operable Unit 1-07B* (DOE-ID 2003a), were performed during FY 2003 and FY 2004. The *Monitored Natural Attenuation 2003 Performance and Compliance Monitoring Annual Report for Test Area North Operable Unit 1-07B* (DOE-ID 2004a) and the *Monitored Natural Attenuation 2004 Performance and Compliance Monitoring Annual Report for Test Area North, Operable Unit 1-07B* (ICP 2005) describe these sampling activities, analytical results, well maintenance activities, and groundwater level measurements.

1.1.1 Activities for the Current Reporting Period

The MNA operations at TAN during FY 2005 were conducted in accordance with the performance operations, as outlined by the MNA Remedial Action Work Plan (DOE-ID 2003a). Annual MNA groundwater monitoring activities (performed in August 2005) were governed by the *Monitored Natural Attenuation Operations, Monitoring, and Maintenance Plan for Test Area North, Operable Unit 1-07B* (DOE-ID 2003b), which was written to meet the requirements outlined in the MNA Remedial Action Work Plan (DOE-ID 2003a). Well maintenance activities were governed by the *Well Maintenance Work-off Schedule for Fiscal Years 2003, 2004, and 2005* (INEEL 2003a). Well maintenance performed during FY 2005 is described in Section 2.2.

1.1.2 Future Activities

The performance operations phase will continue until sufficient data are collected to confirm that peak breakthrough of TCE has occurred at monitoring wells within Zone 1. Breakthrough is estimated to be completed within 10 years of the MNA Remedial Action Work Plan (DOE-ID 2003a), and a Zone 1 remedial action report is scheduled to be written for Agency approval in 2013. Based on data presented in the remedial action report, the Agencies will determine whether to (1) extend the performance period, (2) move Zone 1 into long-term operations and continue the performance period for Zone 2, or (3) end the performance period for Zones 1 and 2 and move into the long-term operations phase (DOE-ID 2003a).

The long-term operations phase will consist of periodic groundwater monitoring, as determined by the Agencies, for the duration of the remedial action period. This monitoring will track the remedy's progress toward achieving the remedial action objectives (RAOs). During this phase, MNA will be considered operational and functional. Monitoring requirements are stated in the MNA Remedial Action Work Plan (DOE-ID 2003a).

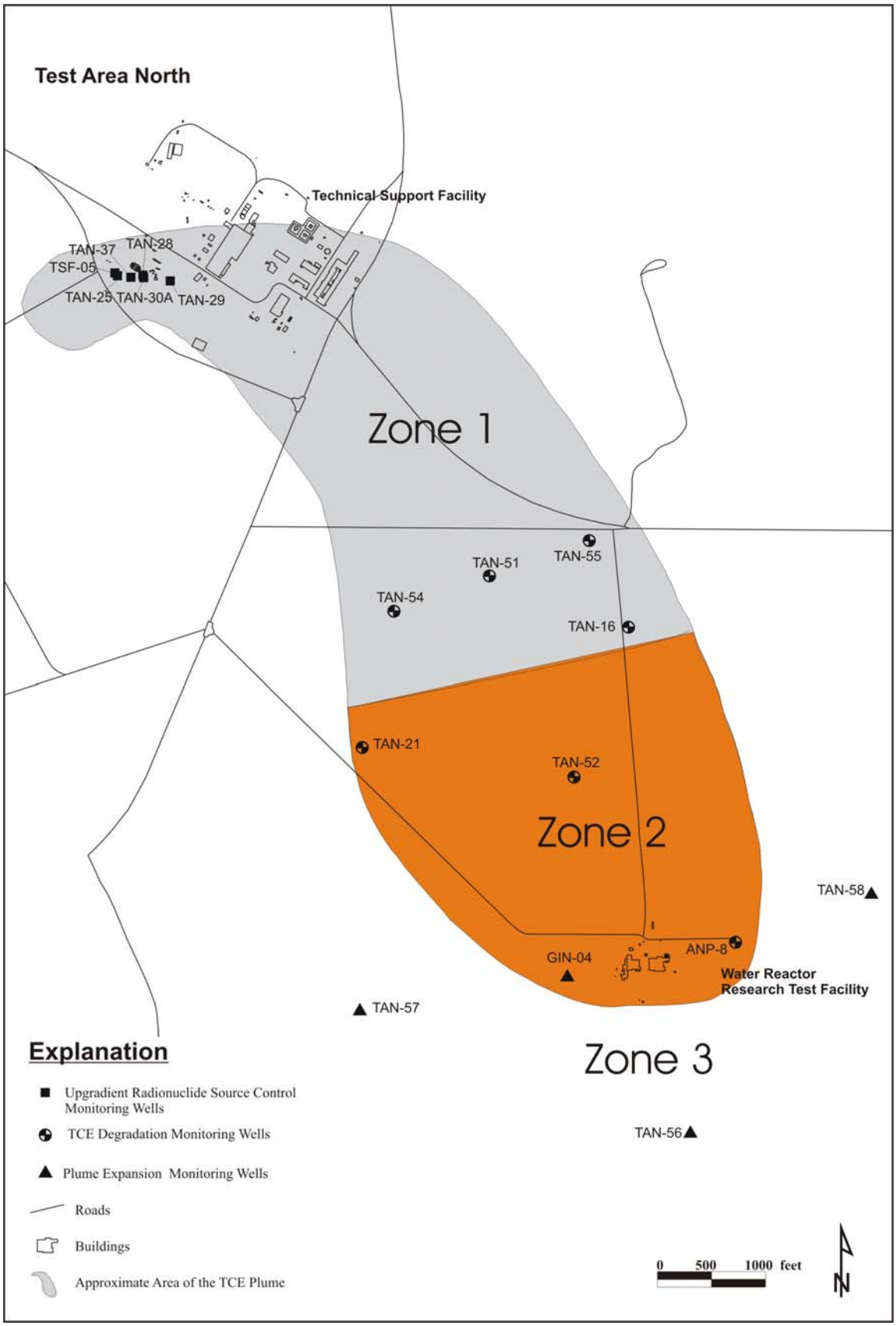

Figure 1. Map of the monitoring well network and zone divisions for monitored natural attenuation.

1.2 Reporting Period Requirements

The requirements for the current MNA groundwater-monitoring program during the performance operations phase include collection of groundwater samples from a representative set of wells in each of the three monitoring zones, as specified in Section 2.1. Data obtained from the sampling activities are required to be compiled in an annual performance report at least through the performance operations phase. Reported information is to include analytical results, sampling and analysis plan tables, trend analyses, interpretations, operational changes, any maintenance or repair activities associated with the monitoring wells, and an evaluation of MNA remedy progress toward meeting the performance criteria and RAOs. In addition, the report must include quality assurance (QA) and quality control (QC) results (DOE-ID 2003a) and discussions of any discrepancies from the MNA Operations, Monitoring, and Maintenance Plan (DOE-ID 2003b). Since Zone 3 wells were sampled during FY 2003, only Zone 1 and Zone 2 wells were required to be sampled during FY 2005.

1.3 Project Objectives

The remedial objectives for groundwater monitoring are established in the MNA Remedial Action Work Plan (DOE-ID 2003a) and include the MNA performance and compliance objectives, as stated herein.

Performance objectives include (1) monitoring to determine that the natural attenuation process continues to trend toward the RAOs for the distal zone of the plume and (2) monitoring to assess plume expansion. Compliance objectives include (1) conducting groundwater monitoring at all MNA performance-monitoring wells at a frequency and duration sufficient to demonstrate that the remedy is operational, functional, and effective and (2) demonstrating at the end of the remedial action period that RAOs for groundwater have been attained.

This annual report presents groundwater monitoring data and data interpretation that demonstrate progress made during FY 2005 toward meeting the performance and compliance objectives.

2. FISCAL YEAR 2005 MONITORED NATURAL ATTENUATION GROUNDWATER MONITORING ACTIVITIES

This section provides an overview of activities performed during FY 2005 in support of the MNA remedy. Groundwater sampling was conducted at all monitoring wells located in Zones 1 and 2 to meet annual sampling requirements, as outlined in the MNA Operations, Monitoring, and Maintenance Plan (DOE-ID 2003b), and to monitor contaminant of concern concentrations to confirm that they continue to trend toward meeting the RAOs. Vertical profile groundwater sampling was performed in some wells in order to provide contaminant concentration profiles with depth. Water levels were measured in wells located throughout the contaminant plume and surrounding areas to monitor the groundwater gradient and direction of flow. A summary of monitoring well maintenance activities also is included.

The MNA Operations, Monitoring, and Maintenance Plan (DOE-ID 2003b) requires monitoring Zone 3 wells every 3 years. However, since minimal collection of TCE concentrations at the southern extent of the plume has been performed in the past, an additional round of monitoring was performed at TAN-57 during FY 2004 and FY 2005. TAN-57 was chosen because TCE was observed at detectable concentrations below the maximum contaminant level (MCL) during FY 2003 and FY 2004 sampling (ICP 2005).

Field parameters include water levels, pH, temperature, specific conductivity, and dissolved oxygen (DO). With the exception of water levels, all field parameters were measured during well purging

using a multiparameter water-quality instrument. Water levels were measured in 89 TAN wells on June 13–14, 2005. Field parameters are presented in Appendix A (Tables A-1 and A-2).

2.1 Groundwater Sampling and Analysis

In order to monitor the performance of MNA at TAN, samples were collected and analyzed for contaminants of concern from a monitoring well network of 17 wells (Table 1 and Figure 1) (DOE-ID 2003b) plus an additional Zone 1 well (TAN-48). The monitoring strategy is intended to monitor whether the natural attenuation process continues to trend toward the RAOs in Zones 1 and 2 and to monitor plume expansion in Zone 3. Wells in Zones 1 and 2 are sampled and analyzed annually during performance operations. Wells in Zone 3 are sampled and analyzed every 3 years during performance operations, which started in FY 2003. Tritium and VOCs were monitored in wells from all three zones. Radionuclides (Cs-137, Sr-90, and U-234) were monitored in selected Zone 1 wells. Data results are presented in Section 3 and sampling and analysis plan tables are included in Appendix B.

Table 1. Monitoring well network.

Zone	Well	Sampling Frequency	FY 2005 Sampling		
			VOCs[a]	Tritium	Radionuclides[b]
1	TAN-16	Annual	X	X	NA[d]
	TAN-51[c]	Annual	X	X	NA[d]
	TAN-54[c]	Annual	X	X	NA[d]
	TAN-55[c]	Annual	X	X	NA[d]
	TAN-25	Annual	NA[e]	X	X
	TAN-28	Annual	NA[e]	X	X
	TAN-29	Annual	NA[e]	X	X
	TAN-30A	Annual	NA[e]	X	X
	TAN-37	Annual	NA[e]	X	X
	TSF-05	Annual	NA[e]	X	X
2	TAN-52[c]	Annual	X	X	NA[d]
	TAN-21	Annual	X	X	NA[d]
	ANP-8	Annual	X	X	NA[d]
3	GIN-4	Every 3 years	NA[d]	NA[d]	NA[d]
	TAN-56[c]	Every 3 years	NA[d]	NA[d]	NA[d]
	TAN-57[c, f]	Every 3 years	X	X	NA[d]
	TAN-58	Every 3 years	NA[d]	NA[d]	NA[d]

a. TCE, PCE, *cis*-DCE, *trans*-DCE, and vinyl chloride
b. Sr-90, Cs-137, and U-234
c. Well was sampled at multiple depths during FY 2005.
d. Analyses were not required (DOE-ID 2003b).
e. The VOC data are obtained in association with ISB operations.
f. Samples were not required at this location during FY 2005. Sampling was performed to determine the extent of the plume and to determine if TCE concentrations are reproducible or changing.

cis-DCE = *cis*-dichloroethene
DOE-ID = U.S. Department of Energy Idaho Operations Office
FY = fiscal year
ISB = in situ bioremediation
NA = not applicable
PCE = tetrachloroethene
TAN = Test Area North
TCE = trichloroethene
trans-DCE = *trans*-dichloroethene
TSF = Technical Support Facility
VOC = volatile organic compound

As part of the MNA remedy, a number of wells have been equipped with Flexible Liner Underground Technology (FLUTe™) systems, allowing for sample collection at discrete depths. These wells include TAN-51, TAN-52, TAN-54, TAN-55, and TAN-56. Well TAN-57 also was sampled at multiple vertical intervals using a low-flow submersible pump. The primary objective of vertical profile sampling is verification of no large-scale preferential flow paths in the aquifer.

2.2 Well Maintenance

Monitoring well maintenance was performed in accordance with the *Well Maintenance Work-off Schedule for Fiscal Years 2003, 2004, and 2005* (INEEL 2003a). This document established minimum maintenance requirements and procedures for recording and tracking maintenance. The purpose of this well maintenance program is to perform routine maintenance and install standardized equipment within the well network.

Monitoring well maintenance during FY 2005 included the replacement of the galvanized piping in TAN-15, TAN-16, and TAN-17 with stainless steel piping. The pumps at these wells were returned to their original depths. A concrete pad and barriers were installed at ANP-08; however, a survey is still needed for this monitoring well. Grundfos Rediflow2 pumps suspended from a wire line with a Teflon discharge line were installed at both ANP-08 (deployed at 270 ft below land surface [bls]) and at TAN-58 (deployed at 297 ft bls) (ICP 2006).

3. ANALYTICAL RESULTS

This section presents the observed concentrations for VOCs (TCE, PCE, *cis*-dichloroethene [*cis*-DCE], *trans*-dichloroethene [*trans*-DCE], and vinyl chloride and radionuclides (H-3, Cs-137, Sr-90, and U-234) from groundwater monitoring conducted in MNA Zones 1, 2, and 3 during FY 2005. These results are interpreted in Section 4.

3.1 Volatile Organic Compound Data

All MNA samples were analyzed for VOCs, as required by the MNA Operations, Monitoring, and Maintenance Plan (DOE-ID 2003b). These data are presented in Table 2. The MCLs for PCE, TCE, *cis*-DCE, *trans*-DCE, and vinyl chloride are 5, 5, 70, 100, and 2 µg/L, respectively. Only TCE and PCE were detected at concentrations greater than their respective MCLs. The VOC concentrations in all samples taken from wells within Zone 1 exceeded the MCLs for TCE and PCE. Within Zone 2, PCE concentrations in TAN-21 and ANP-08 were below the MCLs, while TCE also was below the MCLs in TAN-21. All VOCs remained below the MCLs in the Zone 3 well (TAN-57). Samples from the other Zone 2 wells were above the MCLs for TCE and PCE.

3.2 Radionuclide Data

Radionuclide data were collected for performance and compliance monitoring. During past evaluations, tritium has been used as a conservative tracer to monitor plume migration. Therefore, tritium data were collected from all of the MNA monitoring wells. Observed tritium concentrations are included in Table 3. All of the tritium concentrations observed during FY 2005 groundwater monitoring were below the MCL of 20,000 pCi/L. As shown in Table 3, tritium was not detected in TAN-57, TAN-16, TAN-21, and ANP-8.

Radionuclides also were monitored near the residual source area in Zone 1. Data for the radionuclides Cs-137, Sr-90, and U-234 are included in Table 4. The MCLs for Cs-137, Sr-90, and U-234

are 119, 8, and 27 pCi/L, respectively (DOE-ID 1995). Samples were collected from TAN-25, TAN-28, TAN-29, TAN-30A, TAN-37A, TAN-37B, TSF-05A, and TSF-05B. Cesium-137 was detected in TSF-05 and TAN-25 at concentrations above the MCLs. Strontium-90 was detected at concentrations above the MCLs in all of the wells monitored, with the exception of TAN-30A. Uranium-234 activity was below the MCLs in all wells monitored (Table 4).

Table 2. Observed volatile organic compound concentrations from Fiscal Year 2005 monitored natural attenuation groundwater monitoring.

Zone	Well	Well ID	Date	Depth (ft bls)	PCE (µg/L)	TCE (µg/L)	*cis*-DCE (µg/L)	*trans*-DCE (µg/L)	Vinyl Chloride (µg/L)
1			8/17/05	234	9	86.6	3.7	0.79 J	1 U
			8/17/05	318	15.7	110 D	12.5	1.5	1 U
			8/17/05	330.5	15.9	109 D	7.9	1.1	1 U
			8/22/05	347	17.4	132 D	4.5	1.1	1 U
	TAN-54	1340	8/22/05	373	16.8	120 D	4.7	1.1	1 U
			8/22/05	373	17.6	118 D	4.6	1.2	1 U
			8/22/05	394	17.8	139 D	4	1.1	1 U
			8/23/05	420	16	131 D	4	1	1 U
			8/23/05	460	19.4	180 D	5.4	1.4	1 U
			8/25/05	221	6.9	48.9	1.6	0.46 J	1 U
			8/25/05	251	7.8	57.4	1.6	0.4 J	1 U
			8/25/05	265	15.4	152 D	5.2	1.7	1 U
			8/25/05	317	16.3	142 D	5	1.7	1 U
			8/25/05	332	16.4	120 D	4.8	1.7	1 U
	TAN-55	1341	8/25/05	373.5	16.7	134 D	4.1	1.5	1 U
			8/29/05	404	12.3	110 D	4.2	1.4	1 U
			8/29/05	404	13.1	118 D	4.2	1.4	1 U
			8/29/05	439	11	86	2.7	0.93 J	1 U
			8/29/05	449	11	80.4	2.5	0.84 J	1 U
			8/29/05	461	11.4	84.5	2.6	0.86 J	1 U
			8/15/05	240	26	184 D	3.5	0.96 J	1 U
			8/15/05	263	18	84.6	1.4	1 U	1 U
			8/15/05	283.5	9.9	68.9	1.2	0.44 J	1 U
	TAN-51	1316	8/16/05	322	11	47.8	0.79 J	1 U	1 U
			8/16/05	342	9.7	60	1	0.37 J	1 U
			8/16/05	367	7.6	52.8	1	1 U	1 U
			8/16/05	413	24.6	209 D	6.4	2.3	1 U
			8/16/05	460	24.6	190 D	6.2	2.2	1 U
	TAN-16	752	8/15/05	307	7.5	46	1.2	0.38 J	1 U
	TAN-48	1211	8/31/05	273	3.1	41.7	1.7	0.47 J	1 U

Table 2. (continued).

Zone	Well	Well ID	Date	Depth (ft bls)	PCE (µg/L)	TCE (µg/L)	*cis*-DCE (µg/L)	*trans*-DCE (µg/L)	Vinyl Chloride (µg/L)
			8/31/05	317	10.2	140 D	4.8	1.7	1 U
			8/31/05	345	9.3	96.7	3.2	0.98 J	1 U
			9/1/05	381	5.4	65.1	2.4	0.61 J	1 U
			9/1/05	412	2	38.6	2.1	0.58 J	1 U
			9/1/05	431	3.3	50.4	2.7	0.85 J	1 U
2	TAN-52	1317	8/29/05	242	8	51.9	1.2	0.36 J	1 U
			8/29/05	266	8.8	56.4	1.2	0.36 J	1 U
			8/31/05	303	6.9	53.1	1.4	0.46 J	1 U
			8/31/05	361	7	52.1	1.2	0.43 J	1 U
			8/31/05	373	8.6	61	1.6	0.53 J	1 U
			8/31/05	393	7.5	56.2	1.5	0.46 J	1 U
			8/31/05	438	8.9	47.1	0.85 J	1 U	1 U
			8/31/05	456	7.3	41	0.86 J	1 U	1 U
	TAN-21	793	8/23/05	432	2.8	4.7	1 U	1 U	1 U
	ANP-08	76	8/25/04	268	3.7	16.8	1 U	1 U	1 U
3	TAN-57	1343	8/17/05	230	1.8	2.9	1U	1U	1U
			8/29/05	285	1.4	2.7	1U	1U	1U
			8/23/05	353	1.8	4.2	1U	1U	1U
			8/23/05	353	1.8	4.1	1U	1U	1U
			8/22/05	400	1.9	4.4	1U	1U	1U
			8/16/05	438	2.2	4.3	1U	1U	1U

D = result from a diluted run
J = estimated value; results below practical quantification limit
U = below the detection limit

bls = below land surface
cis-DCE = *cis*-dichloroethene
ID = identification
PCE = tetrachloroethene
TAN = Test Area North
TCE = trichloroethene
trans-DCE = *trans*-dichloroethene

Table 3. Tritium results from Fiscal Year 2005 monitored natural attenuation groundwater monitoring.

Zone	Well Name	Well ID	Date	Sample Depth (ft bls)	Tritium (pCi/L)	Detection Limit (pCi/L)	Counting Error (pCi/L)
1	TAN-54	1340	8/17/05	234	552	86.9	±261
			8/17/05	318	666	87.6	±258
			8/17/05	330.5	495	83.9	±255
			8/22/05	347	665	88.4	±259
			8/22/05	373	727	90.1	±261
			8/22/05	373	713	90.7	±264
			8/22/05	394	620	87.7	±259
			8/23/05	420	756	89.4	±257
			8/23/05	460	795	90.1	±257
	TAN-55	1341	8/25/05	221	297	82.1	±260
			8/25/05	251	231 U	81.6	±262
			8/25/05	265	977	90.1	±247
			8/25/05	317	850	88.9	±250
			8/25/05	332	810	89.3	±254
			8/25/05	373.5	756	78	±219
			8/29/05	404	519	89.5	±273
			8/29/05	404	596	91	±273
			8/29/05	439	586	87.6	±262
			8/29/05	449	288	85.2	±271
			8/29/05	461	465	89.1	±274
	TAN-51	1316	8/15/05	240	813	108	±314
			8/15/05	263	192 U	120	±394
			8/15/05	283.5	76.7 U	94.2	±315
			8/16/05	322	-12.1 U	91.8	±313
			8/16/05	342	-80.3 U	89.1	±309
			8/16/05	367	-12U	83.2	±304
			8/16/05	413	1170	96.4	±260
			8/16/05	460	1090	97.1	±266
	TAN-16	752	8/15/05	307	270 U	96.8	±311
	TAN-28	1008	8/16/05	242	3,920	139	±273
	TAN-29	1010	8/16/05	253	1,380	101	±265
	TAN-30A	1012	8/16/05	313	2,360	118	±272
	TAN-25	1117	8/15/05	218	2,810	119	±256
			8/15/05	218	2,840	125	±274
	TAN-37A	1163	8/16/05	240	1,270	99.4	±265

Table 3. (continued).

Zone	Well Name	Well ID	Date	Sample Depth (ft bls)	Tritium (pCi/L)	Detection Limit (pCi/L)	Counting Error (pCi/L)
	TAN-37B	1163	8/16/05	272	1,200	97.6	±262
	TSF-05A	71	8/15/05	235	1,760	107	±264
	TAN-48	1211	8/31/05	273	1,680	105	±262
			8/31/05	317	1,760	108	±268
			8/31/05	345	1,450	102	±265
			9/1/05	381	1,180	97.4	±262
			9/1/05	412	207 U	80.3	±260
			9/1/05	431	329	84	±264
2	TAN-52	1393	8/29/05	242	234 U	85	±274
			8/29/05	266	271	80.2	±255
			8/31/05	303	296	79.1	±250
			8/31/05	361	250 U	81.3	±260
			8/31/05	373	318	81.2	±255
			8/31/05	393	318	80.8	±254
			8/31/05	438	139 U	78.3	±257
			8/31/05	456	166 U	80	±261
	TAN-21	793	8/23/05	432	-65.5 U	69.8	±241
	ANP-08	76	8/25/04	268	65.1 U	78.5	±262
3	TAN-57	1343	8/17/05	230	-44 U	79.5	±272
			8/29/05	285	74.4 U	78.1	±260
			8/29/05	285	-76.1 U	75.6	±261
			8/23/05	353	5.04 U	73	±247
			8/23/05	353	-38.9 U	72.7	±249
			8/22/05	400	49.7 U	72.8	±244
			8/16/05	438	3.54 U	80.8	±274

U = below the detection limit or minimum detectable activity (MDA)

bls = below land surface
ID = identification
TAN = Test Area North
TSF = Technical Support Facility

Table 4. Strontium-90, cesium-137, and uranium-234 results from Fiscal Year 2005 monitored natural attenuation groundwater monitoring.

Well Name	Well ID	Date Collected	Sample Depth (ft bls)	Gamma Spec (Cs-137) (pCi/L)	Sr-90 (pCi/L)	U-233/234 (pCi/L)
TAN-25	1117	8/15/05	218	1,220	1,340	0.783
TAN-25	1117	8/15/05	218	1,290[a]	1,250	0.417
TAN-28	1008	8/16/05	242	1.71 U	227	7.6
TAN-29	1010	8/16/05	253	-0.126 U	8.45	4.18
TAN-30A	1012	8/16/05	313	8.14 U	0.086 U	7.42
TAN-37A	1163	8/16/05	240	-1.68 U	553	6.11
TAN-37B	1163	8/16/05	272	2.37[a]	554	6.19
TSF-05A	71	8/15/05	235	1,250	1,610	4.21
TSF-05B	71	8/15/05	270	2,790	2,130	1.12

a. The initial sample results for the TAN-25 duplicate (reported as 0.917 pCi/L) and TAN-37B (reported as 1,390 pCi/L) appeared to be switched. The samples were reanalyzed, which confirmed that the samples had been switched during the initial analysis. The results following the second analysis are reported in the table.

U = below the detection limit or minimum detectable activity

bls = below land surface
ID = identification
TAN = Test Area North
TSF = Technical Support Facility

3.3 Field Parameters and Water Level Data

Field parameters (including pH, temperature, specific conductivity, and DO) were measured during well purging using a multiparameter water-quality instrument. The final parameter measurement reported prior to sample collection at each well is reported in Appendix A. Water level measurements were collected from all TAN area wells on June 13–14, 2005. The results, in comparison with past water level data, are presented in Appendix A. Comparison of measurements show that water levels are declining in the TAN monitoring wells (this decline is attributed to regional drought conditions and seasonal variations). The average decline in TAN wells from June 2004 to June 2005 was 2.65 ft with a median value of 2.60 ft. Since the decline in water levels are uniform in the area inside and surrounding the OU 1-07B TCE plume, the groundwater flow remains consistent with flow directions previously reported.

3.4 Quality Assurance/Quality Control

The VOC and radionuclide data presented in this section were acquired in accordance with QA/QC procedures (DOE-ID 2003a). Data validation activities identified no significant quality issues affecting the validity of the data presented. Appendix C presents and discusses details of the QA/QC data.

4. DATA EVALUATION

Performance of the MNA remedy is evaluated by determining if the RAOs will be met by the end of long-term operations, as outlined in the MNA Remedial Action Work Plan (DOE-ID 2003a). Specifically, the monitoring data from each reporting period are analyzed to determine if contaminant concentrations continue to trend toward the RAOs for the distal portion of the plume and to determine the extent of the plume. The VOC and radionuclide data are discussed in Sections 4.1 and 4.2, respectively.

4.1 Volatile Organic Compound Analyses

To evaluate success in achieving RAOs for VOCs, the following analyses of VOC data were performed. First, TCE concentration data were evaluated to determine time to peak breakthrough (Section 4.1.1). Second, vertical profiles were constructed to examine concentration changes with depth (Section 4.1.2). Finally, Zone 3 FY 2005 sample results were compared to past results to aid in determining the extent of the plume (Section 4.1.3).

4.1.1 Peak Trichloroethene Breakthrough Analyses

As discussed in the MNA Remedial Action Work Plan (DOE-ID 2003a), a numerical model was developed to determine when peak TCE concentration breakthrough at each well would occur in order to meet the RAOs by 2095. Three predictions were made for each well based on different half-lives, as follows:

1. Actual estimated TCE half-life of 13.2 years
2. A semiconservative estimate of a 14.7-year TCE half-life
3. A conservative estimate of a 20-year TCE half-life (DOE-ID 2003a; INEEL 2003b).

As previously reported, most wells had a predicted peak breakthrough that spanned several years based on the estimated TCE half-lives. The breakthrough analyses are presented in Figures 2 through 5.

As shown in Figure 2, peak breakthrough might have already occurred in 1997 or 1998 in TAN-16. This observation will be confirmed within the next 10 years through continued annual monitoring at this well. Model predictions suggested that peak breakthrough had occurred before 2001 at other Zone 1 MNA wells (TAN-51, TAN-54, and TAN-55) (INEEL 2003b); however, this cannot be confirmed with observational data, as groundwater monitoring in these wells did not begin until 2001 or 2002. If continued groundwater monitoring suggests a declining TCE concentration trend in Zone 1 wells, there will be strong evidence to suggest that the peak TCE concentrations have already traveled beyond these wells.

Zone 2 wells were predicted to have peak breakthroughs ranging from 2007 to 2009 for TAN-52; TAN-21 and ANP-8 were predicted to have breakthroughs from 2018 to 2024 (INEEL 2003b). In general, TCE concentration trends are declining in TAN-21 and increasing slightly in TAN-52 and ANP-8.

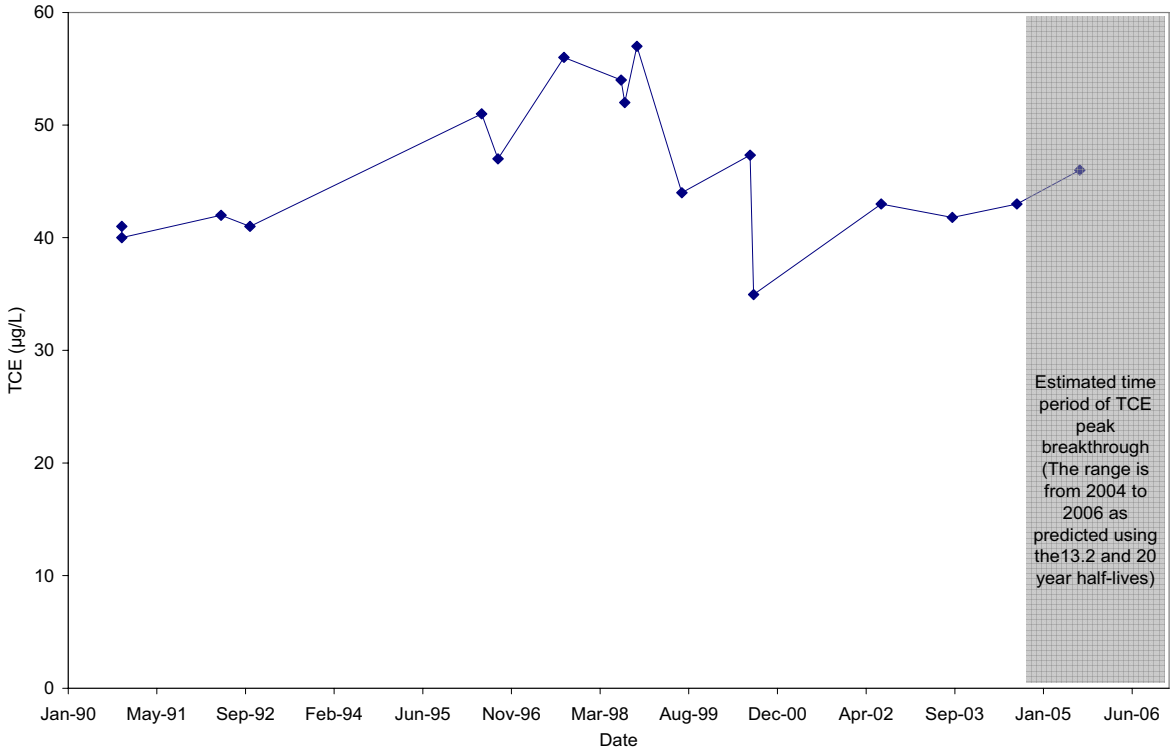

Figure 2. Trichloroethene breakthrough analysis in TAN-16 (Zone 1).

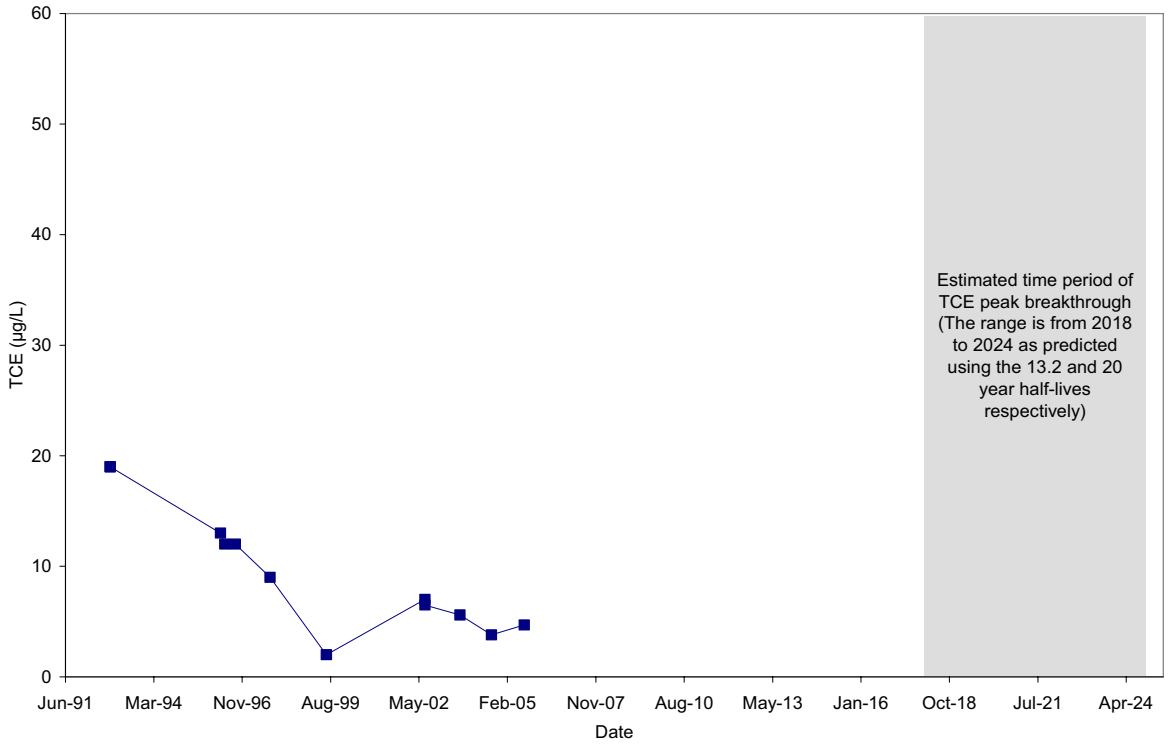

Figure 3. Trichloroethene breakthrough analysis in TAN-21 (Zone 2).

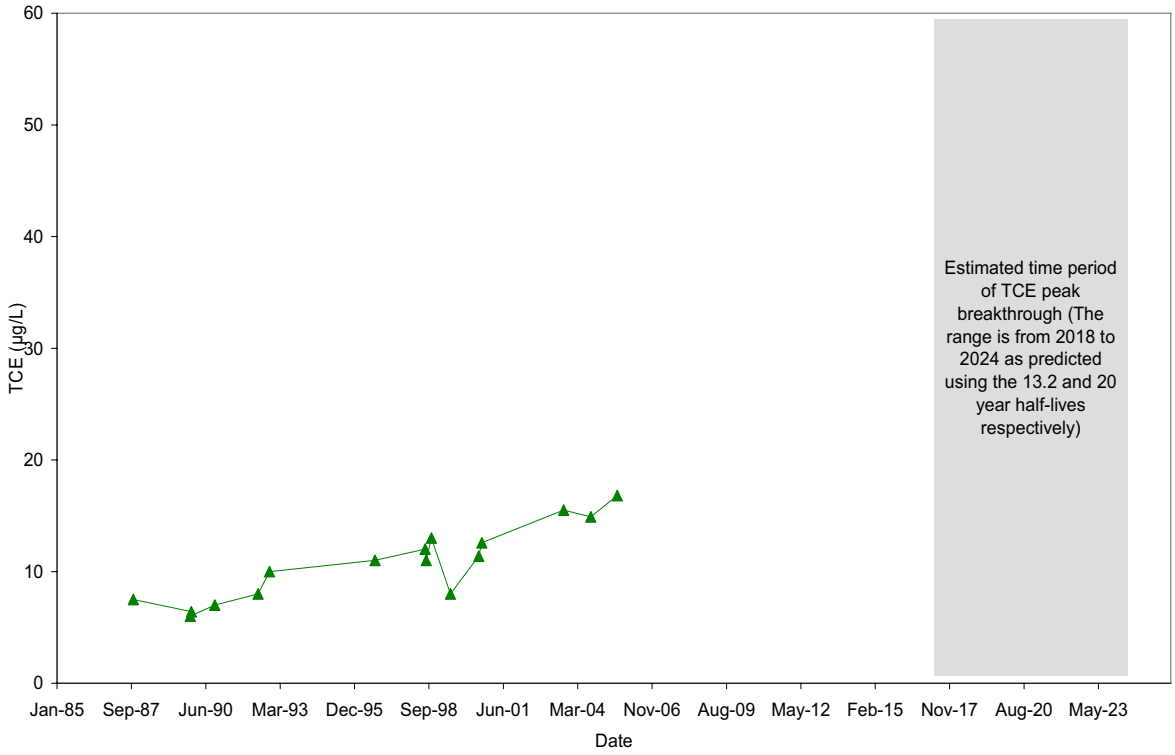

Figure 4. Trichloroethene peak breakthrough analysis in ANP-8 (Zone 2).

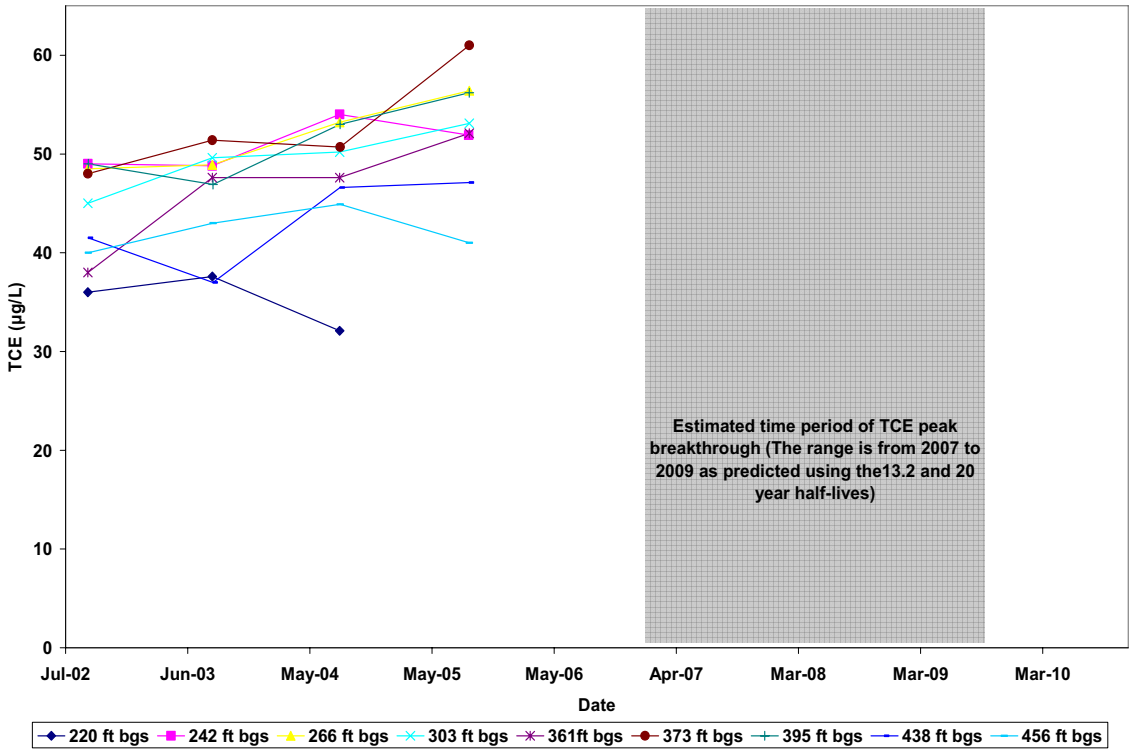

Figure 5. Trichloroethene peak breakthrough analysis in TAN-52 (Zone 2).

4.1.2 Vertical Profiles

Vertical TCE, PCE, and tritium concentration trends in TAN-55, TAN-54, and TAN-51 (Zone 1 wells), as well as TAN-52 (Zone 2 well), are presented in Figures 6 through 9. Historically, tritium and PCE concentrations have been used as conservative tracers to evaluate TCE degradation independent of geohydrological processes using the tracer-corrected method (DOE-ID 2003a). This analysis compared the concentration ratio of TCE to the conservative tracer in groundwater with distance from the residual source to demonstrate reduction in TCE concentrations resulting from intrinsic degradation rather than dilution. Tritium levels in TAN-51 and TAN-52 have dropped below the minimum detectable activity (MDA) at a few depths. Ratios of TCE:PCE and TCE:tritium are presented in Table 5. The TCE:PCE or TCE:tritium ratio was calculated by averaging the vertically discrete concentration data for each well and then taking the natural log of the ratio.

Vertical distribution of TCE, PCE, and tritium are similar within the wells, suggesting that vertical concentration trends are the result of physical aquifer parameters rather than degradation kinetics and chemical processes. As shown in Table 5, the natural log of the TCE to PCE ratios indicates that the variation in TCE:PCE within a single well is small and that ratio decreases with distance from the source area. A decrease in these TCE:PCE ratios with distance from the source suggests that intrinsic TCE degradation is occurring and that observed concentration decreases in TCE are not the result of vertical contaminant distribution or dilution. These ratios were consistent with previously calculated ratios used in the tracer-corrected method (DOE-ID 2003a) to calculate the TCE degradation half-life.

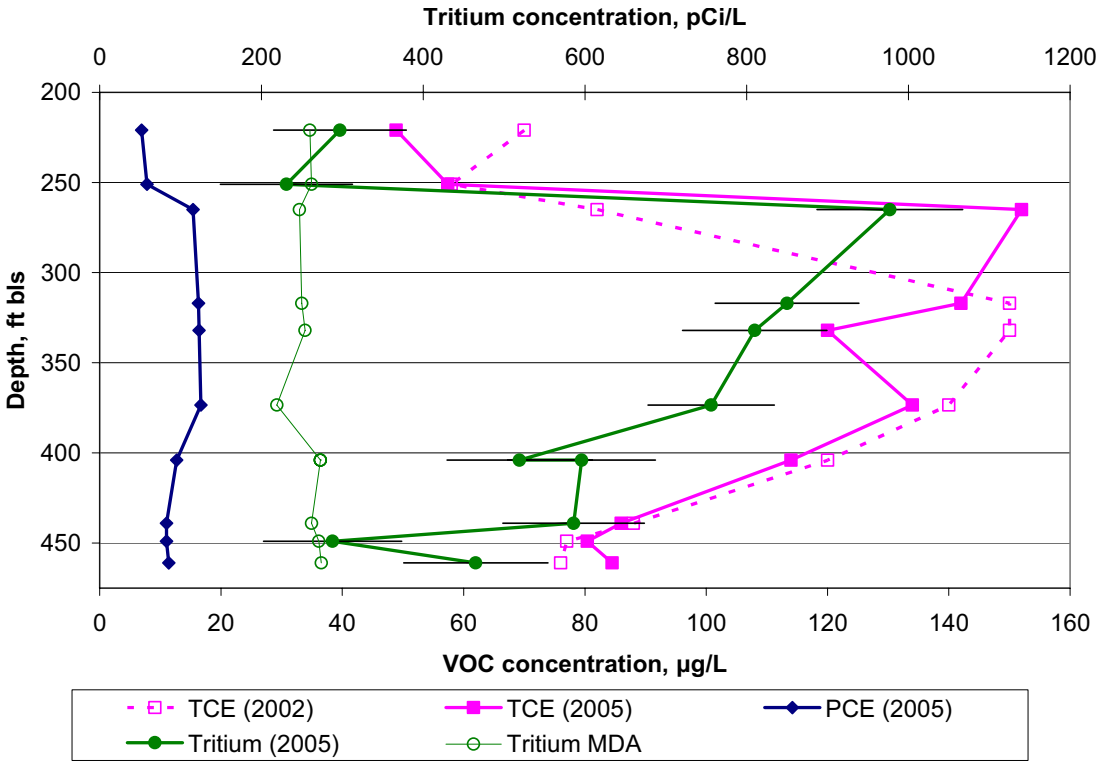

Figure 6. Vertical trichloroethene, tetrachloroethene, and tritium profiles in TAN-55 (Zone 1).

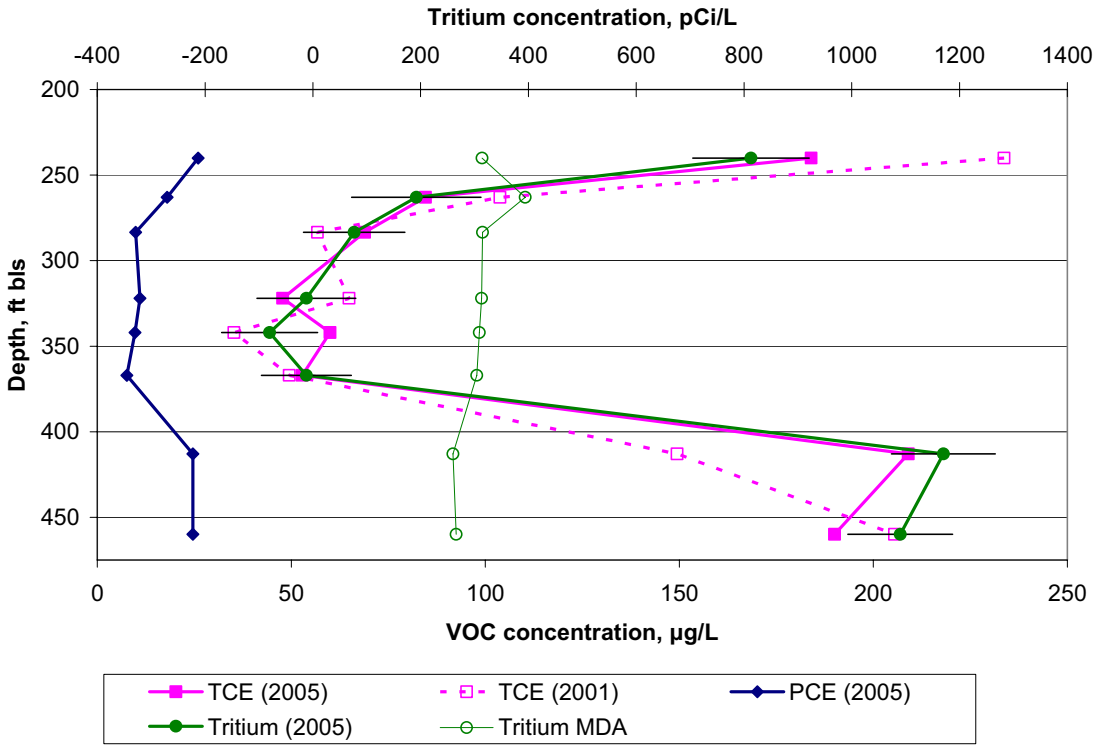

Figure 7. Vertical trichloroethene, tetrachloroethene, and tritium profiles in TAN-51 (Zone 1).

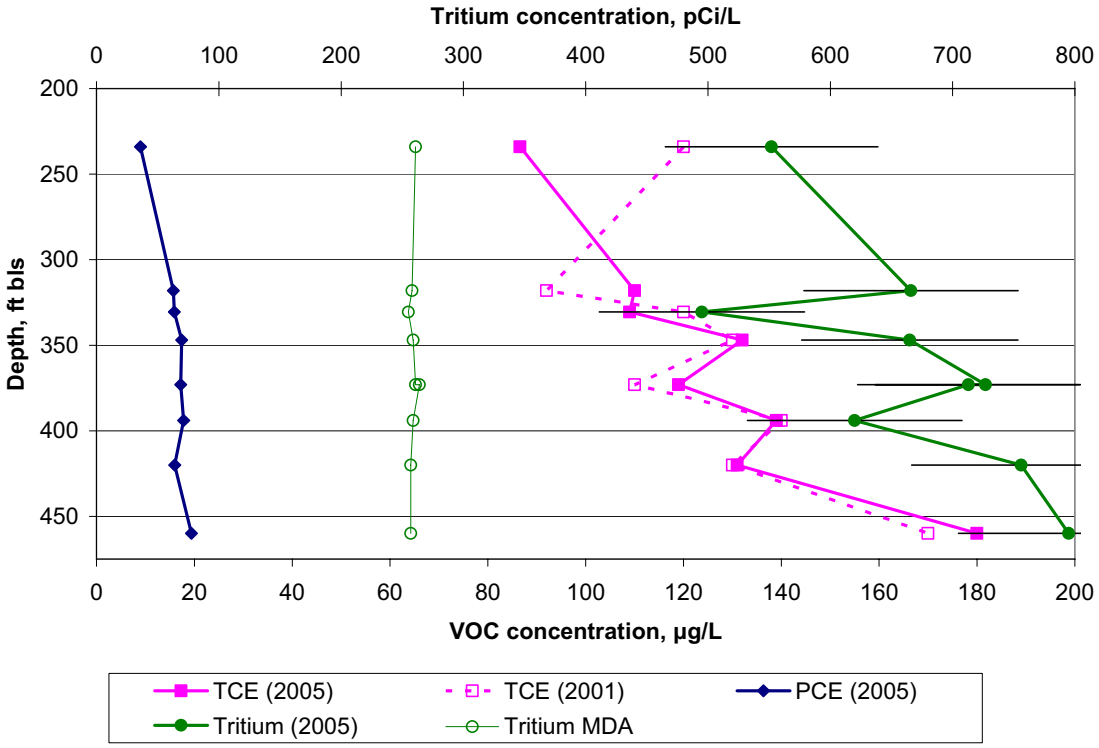

Figure 8. Vertical trichloroethene, tetrachloroethene, and tritium profiles in TAN-54 (Zone 1).

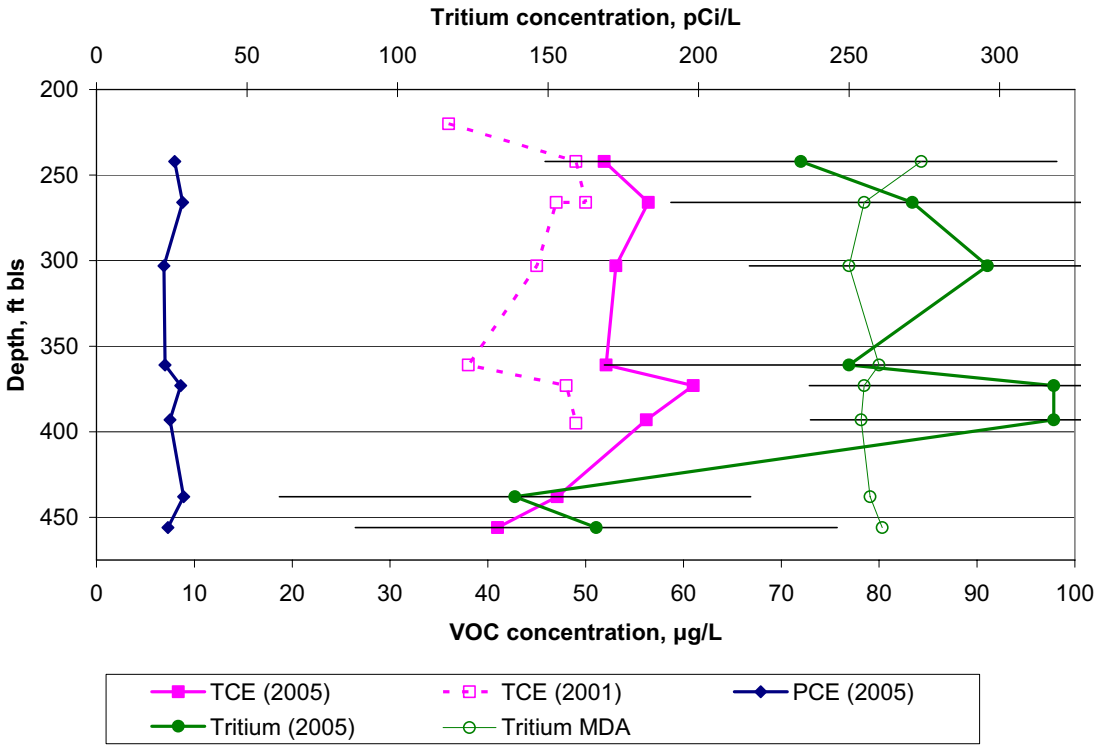

Figure 9. Vertical trichloroethene, tetrachloroethene, and tritium profiles in TAN-52 (Zone 2).

Table 5. Average ratios of trichloroethene:tetrachloroethene and trichloroethene:tritium concentrations with depth in TAN-51, TAN-52, TAN-54, and TAN-55.

Well Name	Distance from TAN-39 (ft)	Natural Log of Average TCE:PCE with Depth (standard deviation)	Previous Range of Natural Log (TCE:PCE) (standard deviation)	Natural Log of Average TCE:Tritium with Depth
TAN-54	3,600[a]	2.04 (0.13)	NA[b]	-1.7
TAN-55	3,600[a]	2.10 (0.11)	NA[b]	-1.8
TAN-51	3,615	1.92 (0.23)	1.78–2.15 (0.13)[c]	-2.2
TAN-52	5,619	1.89 (0.14)	1.64–1.78 (0.09)[c]	-1.7
TAN-57	8,520[a]	0.75 (0.15)	0.73[d] (0.13)	NA[b]

a. The distance from TAN-39 to these wells is approximate.
b. NA indicates that these data are not available or were not collected.
c. Data are from "Degradation Rate Coefficient for Aerobic Trichloroethene Attenuation" (EDF-3739).
d. Data are from the *Monitored Natural Attenuation 2004 Performance and Compliance Monitoring Annual Report for Test Area North, Operable Unit 1-07B* (ICP 2005).

EDF = engineering design file
ICP = Idaho Cleanup Project
PCE = tetrachloroethene
TAN = Test Area North
TCE = trichloroethene

4.1.3 Zone 3 Analysis

An additional round of monitoring was conducted at TAN-57 (Zone 3) to aid in determining the southern extent of the groundwater plume. The TCE and PCE levels in TAN-57 were below the MCLs during FY 2003, FY 2004, and FY 2005. The VOC levels in TAN-57 are listed in Table 2, and TCE and PCE levels are plotted against depth for FY 2003, FY 2004, and FY 2005 in Figure 10. As shown in Figure 10, TCE and PCE concentrations exhibit similar vertical profiles to previous years. There was a slight increase in TCE concentration in TAN-57 as compared to previous years; however, TCE concentrations within this well are still below the MCLs.

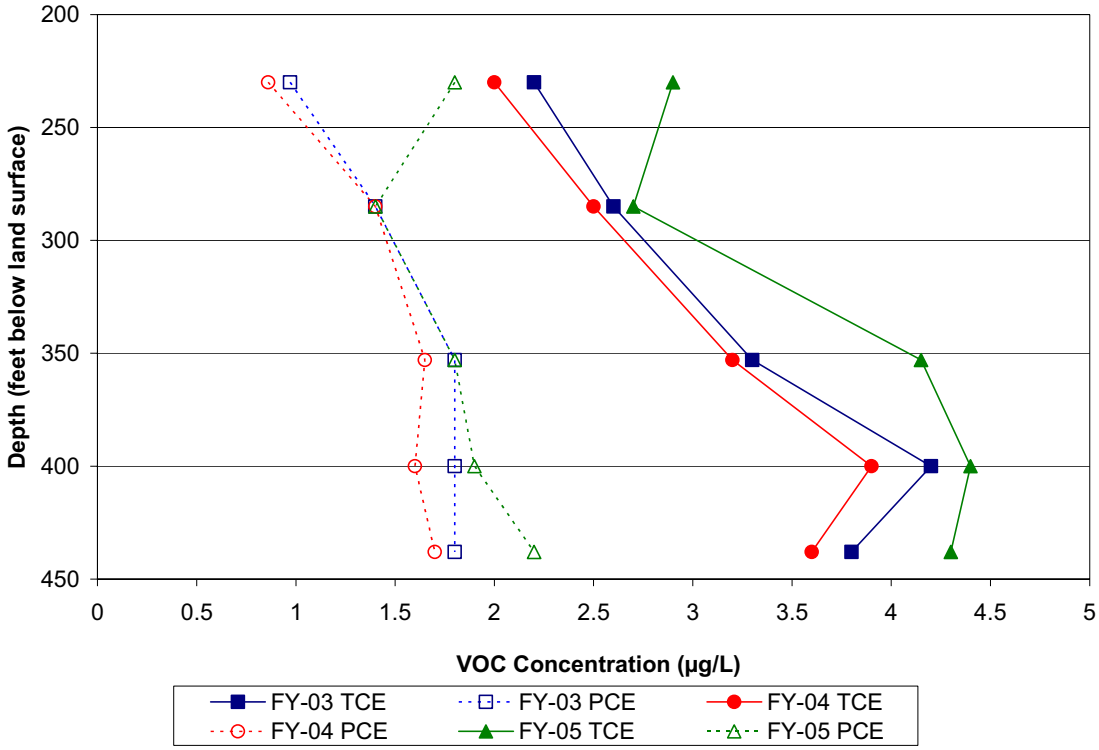

Figure 10. TAN-57 (Zone 3) trichloroethene and tetrachloroethene concentrations with depth for Fiscal Years 2003, 2004, and 2005.

4.2 Radionuclide Analysis

Radioactive decay and sorption of radionuclides to aquifer materials, as discussed in the MNA Remedial Action Work Plan (DOE-ID 2003a), are expected to decrease concentrations of radionuclides in the TAN plume. Cs-137 and Sr-90 concentrations detected above the MDA (Table 4) from 2000 to present are shown in Figures 11 and 12. No migration of Cs-137 or Sr-90 to wells outside the source area was observed during FY 2005.

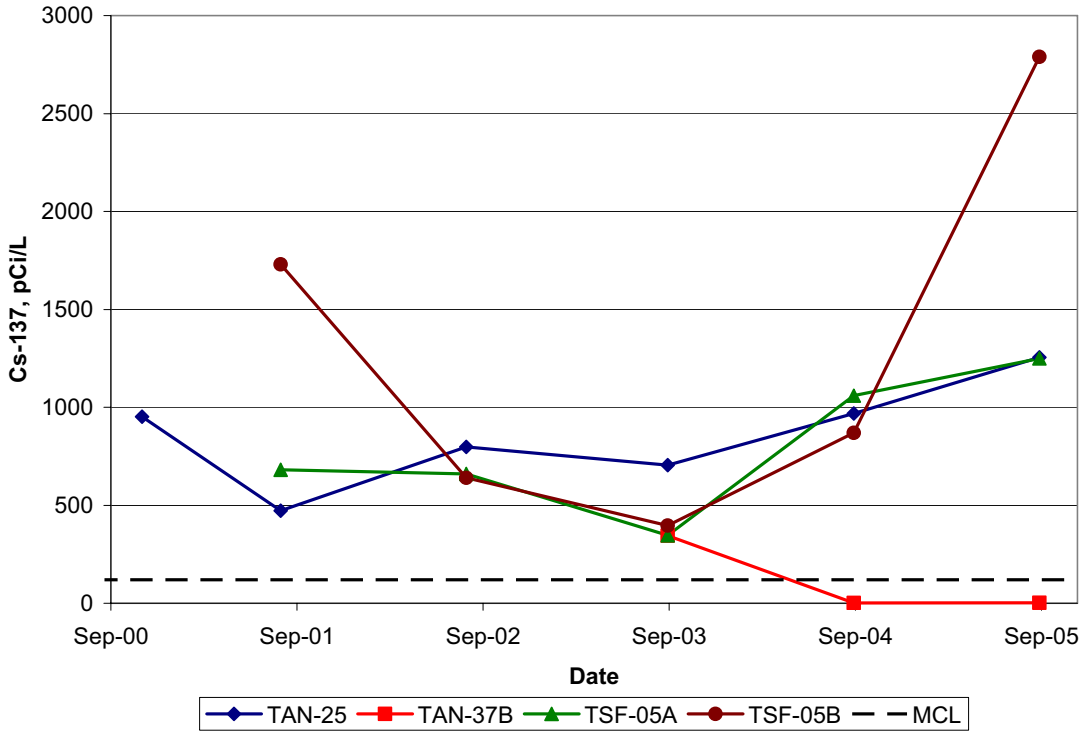

Figure 11. Cesium-137 concentrations in TSF-05A, TSF-05B, TAN-25, and TAN-37B from 2000 to present.

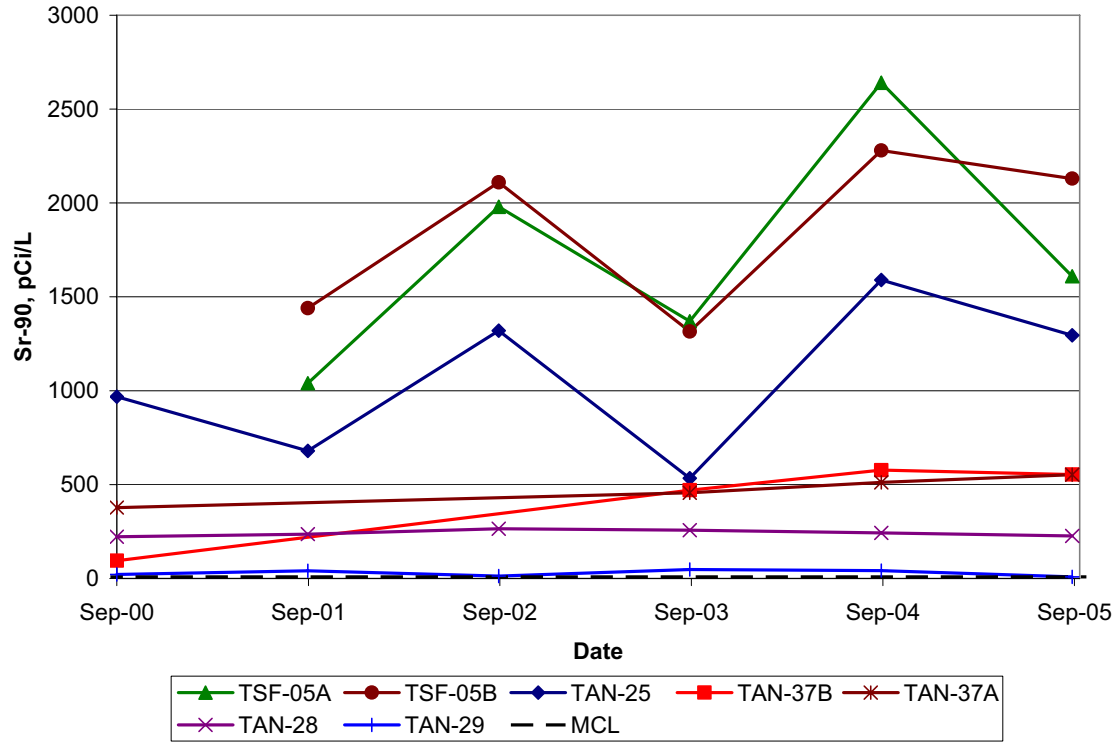

Figure 12. Strontium-90 concentrations in TSF-05A, TSF-05B, TAN-25, TAN-37A, TAN-37B, TAN-28, and TAN-29 from 2000 to present.

5. SUMMARY AND RECOMMENDATIONS

This section provides a summary of the distal zone MNA evaluation developed by integrating historical results with current-year data. The MNA Remedial Action Work Plan (DOE-ID 2003a) outlined the following five components to be assessed during performance operations:

1. Verifying biological mechanisms
2. Updating the numerical transport model
3. Evaluating TCE data (Section 5.1)
4. Evaluating radionuclide data (Section 5.2)
5. Monitoring the size of the contaminated plume (Section 5.3).

The first two components, verifying biological mechanisms and updating the numerical transport model, have been completed; results are documented in the MNA 2003 Performance and Compliance Monitoring Annual Report (DOE-ID 2004a) and the *2003 Update to the Test Area North Large-Scale Groundwater Flow and Transport Model for the Assessment of Monitored Natural Attenuation* (INEEL 2003b). Assessment of the other three components is on-going, as described in the Sections 5.1, 5.2, and 5.3.

5.1 Evaluating Trichloroethene Data

The current data indicate that future groundwater monitoring will provide confirmation of peak breakthrough in TAN-51, TAN-55, and TAN-54 and that future groundwater monitoring will demonstrate peak breakthrough in TAN-16 and Zone 2 wells.

5.2 Evaluating Radionuclide Data

Groundwater monitoring of radionuclides during FY 2005 indicates that the natural attenuation mechanisms for the radionuclides tritium, Cs-137, Sr-90, and U-234, as defined in the MNA Remedial Action Work Plan (DOE-ID 2003a), continue to be functional within the contaminant plume. No migration of Sr-90 or Cs-137 to wells outside the source area was observed. Tritium and U-234 were not detected above the MCLs.

5.3 Monitoring Plume Dimension Changes

Groundwater monitoring of TAN-57 (Zone 3 well) was performed to provide a baseline for future analysis. The TCE and PCE concentrations at this location suggest that there has been no significant plume expansion since FY 2002. All Zone 3 wells will be monitored in FY 2006.

5.4 Recommendations

Recommendations for MNA at the OU 1-07B site for FY 2006 include:

- Continue MNA operations under the performance operations phase for all three zones. As stated in the MNA Remedial Action Work Plan (DOE-ID 2003a), all Zone 3 wells will be sampled during FY 2006.
- A new concrete pad and barriers were installed at ANP-08 (see Section 2.2); however, a survey is still needed for this monitoring well.

6. REFERENCES

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INEEL, 2003b, *2003 Update to the Test Area North Large-Scale Groundwater Flow and Transport Model for the Assessment of Monitored Natural Attenuation*, INEEL/INT-03-00709, Rev. 0, Idaho National Engineering and Environmental Laboratory, November 2003.

Sorenson, K. S., L. N. Peterson, R. L. Ely, and R. E. Hinchee, 2000, "An Evaluation of Aerobic Trichloroethene Attenuation Using First-Order Rate Estimation," *Bioremediation Journal*, 4(4):337–358.

Appendix A

Purge Parameters and Water Levels

Appendix A

Purge Parameters and Water Levels

Table A-1. Field parameter data from Fiscal Year 2005 monitored natural attenuation groundwater monitoring.

Zone	Well	Well ID	Date	Depth (ft bls)	Temp (°C)	pH	Spec. Cond. (ms/cm)	DO (mg/L)
1	TAN-54	1340	8/17/05	234	12.25	7.98	386	1.89
			8/17/05	318	11.56	7.63	412	2.26
			8/17/05	330.5	11.78	7.59	415	2.40
			8/22/05	347	11.57	8.15	408	1.87
			8/22/05	373	11.40	7.84	408	1.88
			8/22/05	394	11.57	7.91	406	1.88
			8/23/05	420	13.44	7.73	445	9.45
			8/23/05	460	12.38	7.98	441	8.43
	TAN-55	1341	8/25/05	221	12.14	7.97	464	6.84
			8/25/05	251	10.99	7.84	461	6.68
			8/25/05	265	11.11	7.71	522	5.65
			8/25/05	317	12.55	7.83	526	5.41
			8/25/05	332	11.35	7.74	518	5.01
			8/25/05	373.5	11.13	7.71	501	6.72
			8/29/05	404	11.30	7.90	494	5.77
			8/29/05	439	11.26	7.75	461	5.94
			8/29/05	449	11.13	7.72	468	6.46
			8/29/05	461	11.19	7.70	465	7.70
	TAN-51	1316	8/15/05	240	11.78	8.09	429	8.49
			8/15/05	263	11.66	7.94	362	10.74
			8/15/05	283.5	11.36	7.82	341	7.88
			8/16/05	322	11.04	8.18	314	9.03
			8/16/05	342	11.05	7.94	304	7.86
			8/16/05	367	11.02	7.83	307	8.86
			8/16/05	413	11.34	7.78	446	6.10
			8/16/05	460	10.99	7.67	448	5.50
	TAN-16	752	8/15/05	307	12.62	7.77	402	6.06

Table A-1. (continued).

Zone	Well	Well ID	Date	Depth (ft bls)	Temp (°C)	pH	Spec. Cond. (ms/cm)	DO (mg/L)
2	TAN-52	1317	8/29/05	242	11.97	7.93	430	6.90
			8/29/05	266	11.42	7.65	418	6.60
			8/31/05	303	11.20	7.75	436	5.98
			8/31/05	361	10.70	7.57	433	3.98
			8/31/05	373	10.74	7.64	434	7.07
			8/31/05	393	11.13	7.80	430	6.85
			8/31/05	438	10.90	7.72	408	6.04
			8/31/05	456	10.81	7.61	411	5.82
	TAN-21	793	8/23/05	432	11.03	9.55	195	1.62
	ANP-08	76	8/25/04	268	13.45	8.13	362	5.24
3	TAN-57	1343	8/17/05	230	13.20	8.02	315	5.62
			8/29/05	285	12.21	7.93	341	8.52
			8/23/05	353	13.81	6.83	366	9.27
			8/22/05	400	11.95	7.89	340	0.80
			8/16/05	438	12.42	7.95	351	2.04
1	TAN-48	1211	8/31/05	273	11.00	7.87	592	7.19
			8/31/05	317	10.76	7.67	535	7.09
			8/31/05	345	10.72	7.62	511	6.77
			9/1/05	381	11.07	7.83	355	5.19
			9/1/05	412	10.75	7.77	357	4.60
			9/1/05	431	10.84	7.76	354	4.66

bls = below land surface
DO = dissolved oxygen
ID = identification
TAN = Test Area North

Table A-2. Water level measurements for 2005.

Well	Measuring Point Elevation (ft)	2005 Depth to Water (ft)	2005 Water Elevation (ft)	Water Level Change, ft (from 2004 to 2005)	2004 Water Elevation (ft)	2004 Depth to Water (ft)	Water Level Change, ft (from 2003 to 2004)	Water Level Change, ft (from 2002 to 2003)	Water Level Change, ft (from 2000 to 2003)
TAN 2005 Water Levels									
ANP-5	4,874.65	305.72	4,568.93	-2.52	4,571.45	303.20	0.18	-2.83	-6.11
ANP-6	4,797.05	228.05	4,569.00	-2.49	4,571.49	225.56	0.15	-2.86	-5.72
ANP-7	4,936.68	366.76	4,569.92	-2.56	4,572.48	364.20	0.29	-2.79	-8.01
ANP-8	4,790.67	225.31	4,565.36	-2.72	4,568.08	222.59	—	—	—
ANP-9	4,788.24	234.62	4,553.62	-10.62	4,564.24	224.00	8.47	-3.01	-6.11
ANP-10	4,787.64	232.82	4,554.82	-13.41	4,568.23	219.41	11.39	-3.21	-6.39
FET-DISPOSAL	4,785.85	216.97	4,568.88	-2.52	4,571.40	214.45	0.06	-2.73	-6.25
GIN-1	4,788.11	222.25	4,565.86	-2.75	4,568.61	219.50	-0.27	-2.41	-5.11
GIN-2	4,787.87	221.33	4,566.54	-2.59	4,569.13	218.74	—	—	—
GIN-3	4,788.43	222.09	4,566.34	-2.69	4,569.03	219.40	0.16	-2.81	-5.66
GIN-4	4,788.08	221.67	4,566.41	-3.09	4,569.50	218.58	—	—	—
GIN-5	4,788.31	221.72	4,566.59	-2.65	4,569.24	219.07	0.15	-2.86	-5.73
IET-DISPOSAL[a]	—	225.80	—	-2.57	—	223.23	—	—	—
MW-2	4,789.43	223.10	4,566.33	-2.66	4,568.99	220.44	0.26	-3.02	-5.81
NONAME	4,786.00	219.21	4,566.79	-2.71	4,569.50	216.50	0.21	-3.05	-5.64
OWSLEY-2	4,785.95	235.52	4,550.43	-2.52	4,552.95	233.00	0.07	-2.99	-6.07
P&W-1	4,897.22	328.17	4,569.05	-2.56	4,571.61	325.61	0.26	-2.88	-6.38
P&W-2	4,892.91	325.20	4,567.71	-3.84	4,571.55	321.36	0.16	-2.85	-6.09
P&W-3	4,887.43	319.62	4,567.81	-4.13	4,571.94	315.49	0.19	-2.79	-6.77
PSTF	4,788.23	221.00	4,567.23	-2.80	4,570.03	218.20	0.28	-3.15	-5.58
TANT-MON-A-001	4,782.08	213.29	4,568.79	-2.64	4,571.43	210.65	0.22	—	-6.27
TANT-MON-A-002	—	217.04	—	—	—	—	—	—	—

Table A-2. (continued).

Well	Measuring Point Elevation (ft)	2005 Depth to Water (ft)	2005 Water Elevation (ft)	Water Level Change, ft (from 2004 to 2005)	2004 Water Elevation (ft)	2004 Depth to Water (ft)	Water Level Change, ft (from 2003 to 2004)	Water Level Change, ft (from 2002 to 2003)	Water Level Change, ft (from 2000 to 2003)
TAN 2005 Water Levels									
TAN-04[b]	4,803.61	235.03	4,568.58	-2.65	4,571.23	232.38	0.15	-3.75	-6.04
TAN-04[b]	4,803.61	235.08	4,568.53	-2.69	4,571.22	232.39	—	—	—
TAN-05[b]	4,804.03	235.61	4,568.42	-2.63	4,571.05	232.98	0.15	—	-6.07
TAN-05[b]	4,804.03	235.67	4,568.36	-2.68	4,571.04	232.99	—	—	—
TAN-06	4,788.73	220.41	4,568.32	-2.57	4,570.89	217.84	0.19	-2.82	-5.99
TAN-07	4,788.65	220.55	4,568.10	-2.80	4,570.90	217.75	0.16	-2.84	-5.98
TAN-08	4,791.58	224.10	4,567.48	-2.99	4,570.47	221.11	-0.11	-3.04	-4.75
TAN-09	4,782.62	213.87	4,568.75	-2.60	4,571.35	211.27	0.1	-2.77	-6.24
TAN-10	4,782.73	213.95	4,568.78	-2.57	4,571.35	211.38	0.11	-3.03	—
TAN-10A	4,782.63	213.92	4,568.71	-2.61	4,571.32	211.31	0.12	-2.74	-5.92
TAN-11	4,782.83	213.98	4,568.85	-2.63	4,571.48	211.35	0.12	-2.74	-5.92
TAN-12	4,782.78	213.89	4,568.89	-2.58	4,571.47	211.31	0.12	-2.69	-5.92
TAN-13A	4,782.41	215.27	4,567.14	-3.07	4,570.21	212.20	-0.45	-3.08	-4.53
TAN-14	4,782.69	215.66	4,567.03	-2.82	4,569.85	212.84	-0.29	-2.94	-5.11
TAN-15	4,788.88	222.90	4,565.98	-4.60	4,570.58	218.30	0.13	-2.83	-5.8
TAN-16	4,788.81	220.80	4,568.01	-2.64	4,570.65	218.16	0.15	-2.82	-5.8
TAN-17	4,792.65	225.06	4,567.59	-2.98	4,570.57	222.08	-0.16	—	—
TAN-18	4,804.37	236.27	4,568.10	-2.47	4,570.57	233.80	-0.34	-2.36	-6.27
TAN-19	4,805.67	237.10	4,568.57	-1.60	4,570.17	235.50	-0.9	-2.72	-6.12
TAN-20	4,782.88	214.80	4,568.08	-3.18	4,571.26	211.62	0.42	-3.05	-5.25
TAN-21	4,789.20	222.40	4,566.80	-2.78	4,569.58	219.62	0.13	-2.91	-5.41
TAN-22A	4,788.76	220.69	4,568.07	-2.45	4,570.52	218.24	0.04	-2.73	-6.1
TAN-23A	4,788.60	220.77	4,567.83	-2.65	4,570.48	218.12	0.12	-2.82	-5.82

Table A-2. (continued).

Well	Measuring Point Elevation (ft)	2005 Depth to Water (ft)	2005 Water Elevation (ft)	Water Level Change, ft (from 2004 to 2005)	2004 Water Elevation (ft)	2004 Depth to Water (ft)	Water Level Change, ft (from 2003 to 2004)	Water Level Change, ft (from 2002 to 2003)	Water Level Change, ft (from 2000 to 2003)
TAN-24A	4,790.93	220.38	4,570.55	-0.18	4,570.73	220.20	0.12	-1.15	-4.23
TAN-25[c]	4,783.25	—	—	—	—	—	—	—	—
TAN 2005 Water Levels									
TAN-26	4,783.21	214.41	4,568.80	-2.53	4,571.33	211.88	—	—	—
TAN-27	4,782.41	213.70	4,568.71	-2.61	4,571.32	211.09	0.11	-2.73	-6
TAN-28	4,784.02	215.48	4,568.54	-2.59	4,571.13	212.89	0.04	-2.71	-6.08
TAN-29	4,784.07	215.39	4,568.68	-2.58	4,571.26	212.81	0.07	-2.275	—
TAN-30A	4,784.03	215.39	4,568.64	-2.58	4,571.22	212.81	0.03	-3.06	-6.09
TAN-31[c]	4,784.69	—	—	—	4,571.56	—	—	—	—
TAN-32	4,787.42	218.77	4,568.65	-2.53	4,571.18	216.24	0.08	-2.73	-6.02
TAN-33	4,800.41	231.88	4,568.53	-2.58	4,571.11	229.30	0.06	-2.7	-6.11
TAN-34	4,785.19	216.78	4,568.41	-2.54	4,570.95	214.24	0.09	-2.9	—
TAN-35	4,784.54	216.15	4,568.39	-2.82	4,571.21	213.33	0.08	-2.7	—
TAN-36	4,796.35	227.77	4,568.58	-2.51	4,571.09	225.26	0.07	-2.74	-6.01
TAN-37	4,784.35	215.61	4,568.74	-2.56	4,571.30	213.05	0.04	-2.79	-6.14
TAN-38[a]	—	230.66	—	—	—	—	—	—	—
TAN-39[a]	—	232.24	—	—	—	—	—	—	—
TAN-40[a]	—	216.63	—	—	—	—	—	—	—
TAN-41	4,785.94	217.33	4,568.61	-2.54	4,571.15	214.79	0.06	-2.73	-6.1
TAN-42	4,802.58	234.01	4,568.57	-2.51	4,571.08	231.50	0.05	-2.7	-6.15
TAN-43	4,801.78	233.20	4,568.58	-2.27	4,570.85	230.93	0.11	-2.71	-6.45
TAN-44	4,800.75	232.22	4,568.53	-1.73	4,570.26	230.49	0.11	-2.47	-7.01
TAN-45	4,797.71	229.09	4,568.62	-2.53	4,571.15	226.56	0.1	-2.71	-6.06
TAN-46	4,796.36	227.77	4,568.59	-2.60	4,571.19	225.17	0.12	-2.7	-6.01

Table A-2. (continued).

Well	Measuring Point Elevation (ft)	2005 Depth to Water (ft)	2005 Water Elevation (ft)	Water Level Change, ft (from 2004 to 2005)	2004 Water Elevation (ft)	2004 Depth to Water (ft)	Water Level Change, ft (from 2003 to 2004)	Water Level Change, ft (from 2002 to 2003)	Water Level Change, ft (from 2000 to 2003)
TAN-47	4,790.51	222.37	4,568.14	-3.00	4,571.14	219.37	-0.13	-3.04	-4.93
TAN-48	4,790.20	221.10	4,569.10	-2.62	4,571.72	218.48	0.28	-2.91	-5.59
TAN-49	4,783.65	214.95	4,568.70	-2.57	4,571.27	212.38	0.06	—	—
TAN-50[b]	4,790.84	222.34	4,568.50	-2.70	4,571.20	219.64	0.16	-2.7	-5.97
TAN-50[b]	4,790.84	222.31	4,568.53	-2.68	4,571.21	219.63	—	—	—
TAN 2005 Water Levels									
TAN-51	4,788.59	220.22	4,568.37	-2.70	4,571.07	217.52	0.71	-3.44	-5.58
TAN-52	4,788.00	221.90	4,566.10	-2.66	4,568.76	219.24	0.24	-4.07	-6.48
TAN-54	4,789.36	221.36	4,568.00	-2.76	4,570.76	218.60	0.38	-3.15	-5.24
TAN-55	4,789.64	221.11	4,568.53	-2.59	4,571.12	218.52	0.26	-2.97	-5.5
TAN-56	4,790.05	223.56	4,566.49	-2.54	4,569.03	221.02	0.06	-2.38	-5.35
TAN-57	4,790.30	226.85	4,563.45	-2.59	4,566.04	224.26	0.03	-2.92	-5.69
TAN-58	4,791.70	224.97	4,566.73	-2.53	4,569.26	222.44	0.11	-2.86	-5.93
TAN-1859[c]	4,785.23	—	4,785.23	—	4,571.18	214.05	0.02	—	—
TAN-1860	4,784.99	216.28	4,568.71	-2.57	4,571.28	213.71	0.03	—	—
TAN-1861	4,785.53	216.80	4,568.73	-2.57	4,571.30	214.23	0.06	—	—
TCH 1[a]	—	212.65	—	-2.58	—	210.07	—	—	—
TAN-CH2 MON. 1	4,791.94	215.87	4,576.07	-0.93	4,577.00	214.94	0.3	-0.35	—
TAN-CH2 MON. 2	4,791.94	225.25	4,566.69	-2.45	4,569.14	222.80	0.01	-2.65	—
TAN-D1[d]	4,789.21	—	—	—	—	—	—	-2.82	-5.93
TAN-D2	4,782.95	214.13	4,568.82	-2.59	4,571.41	211.54	—	—	—
TAN-D3[d]	4,780.00	—	—	—	—	—	—	-2.89	-6.31
TSF-05[c]	4,783.34	—	4,783.34	211.84	4,571.50	211.84	-0.09	—	—
USGS-07	4,790.81	224.43	4,566.38	-2.50	4,568.88	221.93	0.07	-2.82	-5.96

Table A-2. (continued).

Well	Measuring Point Elevation (ft)	2005 Depth to Water (ft)	2005 Water Elevation (ft)	Water Level Change, ft (from 2004 to 2005)	2004 Water Elevation (ft)	2004 Depth to Water (ft)	Water Level Change, ft (from 2003 to 2004)	Water Level Change, ft (from 2002 to 2003)	Water Level Change, ft (from 2000 to 2003)
USGS-24	4,796.99	228.43	4,568.56	-2.60	4,571.16	225.83	0.07	-2.71	-6.08
USGS-25	4,850.87	281.98	4,568.89	-2.48	4,571.37	279.50	0.15	-2.84	-6.14
USGS-26	4,790.65	221.95	4,568.70	-2.45	4,571.15	219.50	0.04	-2.73	-6.22
USGS-OBS-A-126A[a]	—	422.24	—	-2.55	—	419.69	—	—	—
USGS-OBS-A-126B[a]	—	422.83	—	-2.52	—	420.31	—	—	—

a. No surveyed measuring point elevation. Depth to water was measured from the top of the casing. Change in water level was figured from 2004 and 2005 depth to water.
b. Duplicate measurement.
c. No measurement was taken in 2005 because of the possibility of contaminating the water level instrument.
d. No measurement was taken because of the confined space location.

IET = initial engine test
TAN = Test Area North
TSF = Technical Support Facility
USGS = United States Geological Survey

Appendix B

Sampling and Analysis Plan Tables

Sampling and Analysis Plan Table for Chemical and Radiological Analysis

Plan Table Number: MNA-FY2005

SAP Number: DOE/ID-11066

Date: 07/25/2005 Plan Table Revision: 0.0 Project: MNA PERFORMANCE OPERATIONS (ANNUAL, FY-05) Project Manager: NELSON, L. O. SMO Contact: MCGRIFF, T. W.

Sample Description						Sample Location				Enter Analysis Types (AT) and Quantity Requested																			
										AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
Sampling Activity	Sample Type	Sample Matrix	Coll Type	Sampling Method	Planned Date	Area	Type of Location	Location	Depth (ft)	R4	R8	R8	R9	VA															
MNA275	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-51 (1316)	240			1		1															
MNA276	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-51 (1316)	263			1		1															
MNA277	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-51 (1316)	283.5			1		1															
MNA278	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-51 (1316)	322			1		1															
MNA279	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-51 (1316)	342			1		1															
MNA280	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-51 (1316)	367			D 1		T 1															
MNA281	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-51 (1316)	413			1		1															
MNA282	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-51 (1316)	460			1		1															
MNA283	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-54 (1340)	234			1		1															
MNA284	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-54 (1340)	318			1		1															
MNA285	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-54 (1340)	330.5			1		1															
MNA286	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-54 (1340)	347			1		1															
MNA287	REG/QC	GROUND WATER	DUP		08/15/2005	TAN	MONITORING WELL	TAN-54 (1340)	373			2		2															
MNA288	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-54 (1340)	394			1		1															
MNA289	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-54 (1340)	420			1		1															

The sampling activity displayed on this table represents the first 6 to 9 characters of the sample identification number.

The complete sample identification number will appear on the sample labels.

D - Double QC Volume T - Triple QC Volume

AT1: Gamma Spec

AT2: Sr-90

AT3: Tritium

AT4: U-Iso

AT5: VOCs (TAL)

AT6:

AT7:

AT8:

AT9:

AT10:

AT11:

AT12:

AT13:

AT14:

AT15:

AT16:

AT17:

AT18:

AT19:

AT20:

Comments:

VOCs TAL = Vinyl Chloride, Trichloroethene, Tetrachloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene

Gamma Spec = analyte of concern is Cs-137

Analysis Suites:

Contingencies:

Sampling and Analysis Plan Table for Chemical and Radiological Analysis

Plan Table Number: MNA-FY2005

SAP Number: DOE/ID-11056

Date: 07/25/2005 Plan Table Revision: 0.0 Project: MNA PERFORMANCE OPERATIONS (ANNUAL, FY-05) Project Manager: NELSON, L. O. SMO Contact: MCGRIFF, T. W.

Sample Description						Sample Location				Enter Analysis Types (AT) and Quantity Requested																				
										AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
Sampling Activity	Sample Type	Sample Matrix	Coll Type	Sampling Method	Planned Date	Area	Type of Location	Location	Depth (ft)	R4	RB	R8	R9	VA																
MNA290	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-54 (1340)	460			D 1		T 1															
MNA291	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-55 (1341)	221			1		1															
MNA292	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-55 (1341)	251			1		1															
MNA293	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-55 (1341)	265			1		1															
MNA294	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-55 (1341)	317			1		1															
MNA295	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-55 (1341)	332			1		1															
MNA296	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-55 (1341)	373.5			1		1															
MNA297	REG/QC	GROUND WATER	DUP		08/15/2005	TAN	MONITORING WELL	TAN-55 (1341)	404			2		2															
MNA298	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-55 (1341)	439			D 1		T 1															
MNA299	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-55 (1341)	449			1		1															
MNA300	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-55 (1341)	461			1		1															
MNA301	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-52 (1317)	220			1		1															
MNA302	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-52 (1317)	242			1		1															
MNA303	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-52 (1317)	266			1		1															
MNA304	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-52 (1317)	303			1		1															

The sampling activity displayed on this table represents the first 6 to 9 characters of the sample identification number.

The complete sample identification number will appear on the sample labels.

D - Double QC Volume T - Triple QC Volume

AT1: Gamma Spec

AT2: Sr-90

AT3: Tritium

AT4: U-Iso

AT5: VOCs (TAL)

AT6:

AT7:

AT8:

AT9:

AT10:

AT11:

AT12:

AT13:

AT14:

AT15:

AT16:

AT17:

AT18:

AT19:

AT20:

Comments:

VOCs TAL = Vinyl Chloride, Trichloroethene, Tetrachloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene

Gamma Spec = analyte of concern is Cs-137

Analysis Suites:

Contingencies:

Sampling and Analysis Plan Table for Chemical and Radiological Analysis

Plan Table Number: MNA-FY2005

SAP Number: DOE/ID-11066

Date: 07/25/2005 Plan Table Revision: 0.0 Project: MNA PERFORMANCE OPERATIONS (ANNUAL, FY-05) Project Manager: NELSON, L. O. SMO Contact: MCGRIFF, T. W.

Sample Description						Sample Location				Enter Analysis Types (AT) and Quantity Requested																			
Sampling Activity	Sample Type	Sample Matrix	Coll Type	Sampling Method	Planned Date	Area	Type of Location	Location	Depth (ft)	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
										R4	RB	R8	R9	VA															
MNA305	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-52 (1317)	361			1		1															
MNA306	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-52 (1317)	373			1		1															
MNA307	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-52 (1317)	395			1		1															
MNA308	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-52 (1317)	438			1		1															
MNA309	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-52 (1317)	456			1		1															
MNA310	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	ANP-8 (76)	268			D 1		T 1															
MNA311	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-21 (793)	432			1		1															
MNA312	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-16 (752)	307			1		1															
MNA313	REG/QC	GROUND WATER	DUP		08/15/2005	TAN	MONITORING WELL	TAN-25 (1117)	218	2	2	2	2																
MNA314	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-28 (1008)	242	1	1	1	1																
MNA315	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-29 (1010)	253	1	D 1	1	D 1																
MNA316	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-30A (1012)	313	1	1	1	1																
MNA317	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-37A (1163)	240	1	1	1	1																
MNA318	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-37B (1163)	272	1	1	1	1																
MNA319	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TSF-05A (71)	235	1	1	1	1																

The sampling activity displayed on this table represents the first 6 to 9 characters of the sample identification number.

The complete sample identification number will appear on the sample labels.

D - Double QC Volume T - Triple QC Volume

AT1: Gamma Spec

AT2: Sr-90

AT3: Tritium

AT4: U-Iso

AT5: VOCs (TAL)

AT6:

AT7:

AT8:

AT9:

AT10:

AT11:

AT12:

AT13:

AT14:

AT15:

AT16:

AT17:

AT18:

AT19:

AT20:

Comments:

VOCs TAL = Vinyl Chloride, Trichloroethene, Tetrachloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene

Gamma Spec = analyte of concern is Cs-137

Analysis Suites:

Contingencies:

Sampling and Analysis Plan Table for Chemical and Radiological Analysis

Plan Table Number: MNA-FY2005

SAP Number: DOE/ID-11066

Date: 07/25/2005 Plan Table Revision: 0.0 Project: MNA PERFORMANCE OPERATIONS (ANNUAL, FY-05) Project Manager: NELSON, L. O. SMO Contact: MCGRIFF, T. W.

Sample Description						Sample Location				Enter Analysis Types (AT) and Quantity Requested																			
Sampling Activity	Sample Type	Sample Matrix	Coll Type	Sampling Method	Planned Date	Area	Type of Location	Location	Depth (ft)	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
										R4	RB	R8	R9	VA															
MNA320	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TSF-05B (71)	270	1	1	1	1																
MNA321	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-57 (1343)	230			D 1		T 1															
MNA322	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-57 (1343)	285			1		1															
MNA323	REG/QC	GROUND WATER	DUP		08/15/2005	TAN	MONITORING WELL	TAN-57 (1343)	353			2		2															
MNA324	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-57 (1343)	400			1		1															
MNA325	REG	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-57 (1343)	438			1		1															
MNA326	DRY	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-48 (1211)	225			1		1															
MNA327	DRY	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-48 (1211)	273			1		1															
MNA328	DRY	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-48 (1211)	317			1		1															
MNA329	DRY	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-48 (1211)	345			1		1															
MNA330	DRY	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-48 (1211)	381			1		1															
MNA331	DRY	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-48 (1211)	412			1		1															
MNA332	DRY	GROUND WATER	GRAB		08/15/2005	TAN	MONITORING WELL	TAN-48 (1211)	431			1		1															
MNA333	QC	WATER	FBLK		08/15/2005	TAN	FIELD BLANK	QC	NA	1	1	1	1	1															
MNA334	QC	WATER	FBLK		08/15/2005	TAN	FIELD BLANK	QC	NA			1		1															

The sampling activity displayed on this table represents the first 6 to 9 characters of the sample identification number.

The complete sample identification number will appear on the sample labels.

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AT1: Gamma Spec

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Contingencies:

Sampling and Analysis Plan Table for Chemical and Radiological Analysis

Plan Table Number: MNA-FY2005

SAP Number: DOE/ID-11066

Date: 07/25/2005 Plan Table Revision: 0.0 Project: MNA PERFORMANCE OPERATIONS (ANNUAL, FY-05) Project Manager: NELSON, L. O. SMO Contact: MCGRIFF, T. W.

Sample Description						Sample Location				Enter Analysis Types (AT) and Quantity Requested																				
Sampling Activity	Sample Type	Sample Matrix	Coll Type	Sampling Method	Planned Date	Area	Type of Location	Location	Depth (ft)	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
										R4	RB	R8	R9	VA															
MNA335	QC	WATER	FBLK		08/15/2005	TAN	FIELD BLANK	QC	NA			1		1															
MNA336	QC	WATER	TBLK		08/15/2005	TAN	TRIP BLANK	QC	NA					1															
MNA337	QC	WATER	TBLK		08/15/2005	TAN	TRIP BLANK	QC	NA					1															
MNA338	QC	WATER	TBLK		08/15/2005	TAN	TRIP BLANK	QC	NA					1															
MNA339	QC	WATER	TBLK		08/15/2005	TAN	TRIP BLANK	QC	NA					1															
MNA340	QC	WATER	TBLK		08/15/2005	TAN	TRIP BLANK	QC	NA					1															

The sampling activity displayed on this table represents the first 6 to 9 characters of the sample identification number.

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AT15:

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VOCs TAL = Vinyl Chloride, Trichloroethene, Tetrachloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene

Gamma Spec = analyte of concern is Cs-137

Analysis Suites:

Contingencies:

Appendix C

Quality Assurance/Quality Control

Appendix C

Quality Assurance/Quality Control

This section describes the quality assurance/quality control (QA/QC) components of the monitored natural attenuation (MNA) data during Fiscal Year (FY) 2005. These components consist of completeness, validation, precision and accuracy, and comparability of the 2005 MNA data. The FY 2005 data were collected in accordance with the requirements of the *Monitored Natural Attenuation Operations, Monitoring, and Maintenance Plan for Test Area North, Operable Unit 1-07B* (DOE-ID 2003a).

C-1. DATA COMPLETENESS

In accordance with the MNA Operations, Monitoring, and Maintenance Plan (DOE-ID 2003a), 11 wells were required to be sampled for volatile organic compounds (VOCs), 17 wells for tritium, and 8 wells were required to be sampled for radionuclides, including tritium. Appropriate duplicates, field blanks, trip blanks, and matrix spikes (MSs) were required for QA/QC purposes. Table C-1 is a summary of the required and completed sampling and analyses for radionuclides and VOCs. As shown, sampling for all contaminants of concern from the monitoring well network was 100% complete. All duplicate samples were completed as planned. The results of these duplicate samples are included with the presentation of results in Section 3. No analytes were detected in any of the field or trip blanks collected and analyzed. Three field blanks were required for the VOC and tritium data. Trip blanks also were required for each sample cooler that contained samples to be analyzed for VOCs. This was completed as required.

Table C-1. Field and laboratory data completeness summary.

Analyses	Sample Type	Number Required or Planned	Number Collected
TCE, PCE, *cis*-DCE, *trans*-DCE, and vinyl chloride	Primary samples	50	50
	Duplicates	1 per 20 samples = 4	4
	Field blanks	1 per 20 samples = 3	3[a]
	Trip blanks	1 per cooler = 5	3[a, b]
Tritium	Primary samples	58	58
	Duplicates	1 per 20 samples = 4	4
	Field blanks	1 per 20 samples = 3	3[a]
Gamma spec. (Cs-137, Sr-90, and U-234)	Primary samples	8	8
	Duplicates	1 per 20 samples = 1	1
Primary sampling completion			100%

a. This sample type is not included in the calculation of the percent completion.
b. Five trip blanks were planned; however, only three were collected since MNA sampling was completed in a 3-week period and only three sample shipments were made, instead of the planned five.

cis-DCE = *cis*-dichloroethene
PCE = tetrachloroethene
TCE = trichloroethene
trans-DCE = *trans*-dichloroethene

C-2. DATA VALIDATION

Data collected for use in MNA performance and compliance monitoring are definitive-level data requiring a Level B validation during performance operations. This data validation level is required for all analyses specified in the *Monitored Natural Attenuation Remedial Action Work Plan for Test Area North Final Groundwater Remediation, Operable Unit 1-07B* (DOE-ID 2003b). In general, definitive-level data are generated using approved analytical methods. The VOC data were generated using the U.S. Environmental Protection Agency (EPA)-approved method, *Method 8260B, Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry* (EPA 1996). Tritium was analyzed using liquid scintillation counting. Cesium-137 was analyzed using gamma spectrometry. Strontium-90 and U-234 data were produced using gas flow proportional and gross alpha. Data validation requirements were followed according to the requirements summarized in the MNA Operations, Monitoring, and Maintenance Plan (DOE-ID 2003a). Data validation activities identified no significant quality issues affecting the credibility of these data.

C-2.1 Precision

Precision is a measure of reproducibility of measurements under a given set of conditions. Overall precision consists of two components: (1) field precision, which is affected by sample collection methods and natural heterogeneity in the groundwater matrix, and (2) laboratory precision, which is affected by analytical methods. Overall precision can be assessed through the collection of duplicate samples, which for purposes of this project were defined as samples collected for the same analytes from the same location during the same mobilization. Precision in this report is evaluated by calculating the relative percent difference (RPD) of the duplicate samples. The RPD is calculated for field duplicates to represent overall precision (EPA 1996).

The RPD values for field duplicates of VOCs, tritium, and radionuclide samples are presented in Tables C-2 and C-3. For many of the duplicate samples, RPD was not calculated, because the contaminants were not detected in the samples above the method detection limits. For most samples that were non-detect, the duplicate sample also was non-detect. Field duplicate trichloroethene (TCE) samples for which an RPD was calculated were 1.68, 7.02, and 2.41%, meeting the quality-assurance requirement of ±14% for overall precision of TCE sampling and analysis (DOE-ID 2003a). The RPD values of duplicate samples for radionuclides were small for tritium, Sr-90, and Cs-137. The high RPD value of 61% for U-233/234 is calculated from concentrations that were detected, but were very small and well below the maximum contaminant level (MCL).

C-2.2 Accuracy

Accuracy is a measure of bias in the sampling and analysis procedures. Sampling activities that can affect accuracy include preservation, handling, and the sample matrix. All analyses of field and trip blanks collected during Fiscal Year (FY) 2005 sampling showed that analytes were non-detect, indicating that there was no contamination of samples, which would make the analyses inaccurate. The MNA Operations, Monitoring, and Maintenance Plan (DOE-ID 2003a) requires MS recoveries to be within 71 to 120%. The MS and matrix spike duplicate (MSD) results are presented in Table C-4. The MS and MSD recoveries were within the required limits with the exception of the TAN-57 sample, which was 131% of the expected concentration. The RPDs between the MS and MSD were all less than 4%. Field QC and laboratory QA samples and analyses from the FY 2005 MNA groundwater monitoring activities indicate that the data are accurate within the specified limitations.

Table C-2. Volatile organic compound precision as estimated by field duplicates.

Well	PCE RPD (%)	TCE RPD (%)	*cis*-DCE RPD (%)	*trans*-DCE RPD (%)	Vinyl Chloride RPD
TAN-54	4.65	1.68	2.15	8.7	NA[a]
TAN-55	6.30	7.02	0	0	NA[a]
TAN-57	0.00	2.41	0	NA[a]	NA[a]

a. Values were below detection limits.

cis-DCE = *cis*-dichloroethene
NA = not applicable
PCE = tetrachloroethene
RPD = relative percent difference
TAN = Test Area North
TCE = trichloroethene
trans-DCE = *trans*-dichloroethene

Table C-3. Radionuclide precision as estimated by field duplicates.

Well	Tritium RPD (%)	Sr-90 RPD (%)	U-233/234 RPD (%)	Gamma Spec. (Cs-137) RPD (%)
TAN-54	1.9	NA[a]	NA[a]	NA[a]
TAN-55	13.8	NA[a]	NA[a]	NA[a]
TAN-57	NA[a]	NA[a]	NA[a]	NA[a]
TAN-25	1.1	6.95	61.0[b]	5.6

a. Values were below detection limits.
b. The duplicate values were 0.783 and 0.417 pCi/L for U-233/234 at TAN-25. Variability in these low numbers resulted in a relatively high RPD.

NA = not applicable
RPD = relative percent difference
TAN = Test Area North

Table C-4. Matrix spike and matrix spike duplicate results for trichloroethene.

Well	MS Percent Recovery (%)	MSD Percent Recovery (%)	MS/MSD RPD (%)
TAN-51	87	81	3.6
TAN-54	86	82	1.0
TAN-55	131	131	0.0
TAN-57	88	89	0.8
ANP-8	94	97	2.9

MS = matrix spike
MSD = matrix spike duplicate
RPD = relative percent difference
TAN = Test Area North

C-3. COMPARABILITY OF DATA

Data comparability was ensured by following standard sample collection techniques in adherence with the Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10, and Deactivation, Decontamination, and Decommissioning (DOE-ID 2004). The current data are comparable to historical data because there were no deviations from planned sampling techniques, planned (or required) analytical techniques, and no changes in site conditions that would make data incompatible with previously collected data.

C-4. REFERENCES

DOE-ID, 2003a, *Monitored Natural Attenuation Operations, Monitoring, and Maintenance Plan for Test Area North, Operable Unit 1-07B*, DOE/ID-11066, Rev. 0, U.S. Department of Energy Idaho Operations Office, March 2003.

DOE-ID, 2003b, *Monitored Natural Attenuation Remedial Action Work Plan for Test Area North Final Groundwater Remediation, Operable Unit 1-07B*, DOE/ID-11055, Rev. 0, U.S. Department of Energy Idaho Operations Office, June 2003.

DOE-ID, 2004, *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10, and Deactivation, Decontamination, and Decommissioning*, DOE/ID-10587, Rev. 8, U.S. Department of Energy Idaho Operations Office, March 2004.

EPA, 1996, *Method 8260B, Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry*, Rev. 2, U.S. Environmental Protection Agency, Washington, D.C., December 1996 (accessed online at http://www.epa.gov/epaoswer/hazwaste/test/pdfs/8260b.pdf.).